

MISCHER NEUROSCIENCE INSTITUTE **REPORT 2015**



Mischer
Neuroscience Institute

MEMORIAL
HERMANN

The Mischer Neuroscience Institute is a collaboration between Memorial Hermann-Texas Medical Center – part of the Memorial Hermann Health System – and UTHealth Medical School. The Institute draws patients from around the world.

Table of Contents

02	About the Institute <ul style="list-style-type: none">– In Full Bloom: Mischer Neuroscience Institute Approaches Maturity– Connecting the Dots Between Clinics and the Hospital Improves the Patient Experience– Research Update
36	2015 Accolades
40	The Practice of Nursing
58	Scope of Services <ul style="list-style-type: none">– Brain Tumor– Cerebrovascular– Children’s Neuroscience– Epilepsy– Memory Disorders and Dementia– Movement Disorders and Neurodegenerative Diseases– Multiple Sclerosis– Neuromuscular Disorders– Neurorehabilitation– Neurotrauma and Neuroscience Critical Care– Pain Management– Spine Center
106	Research & Innovation
120	Selected Publications
132	Patient Stories
145	Staff Listing

Dear Esteemed Colleagues,

Almost eight years ago, we began the initiative to develop an outstanding neuroscience group to serve the needs of the Greater Houston area. Since then, we've grown strategically at both our Texas Medical Center location and throughout the city. By the end of fiscal year 2015, we had recruited 61 physicians and 33 advanced practice providers to Mischer Neuroscience Associates, the Institute's arm in the community, for a total of 94 clinicians. We now have 14 residents and 10 fellows in the department of Neurosurgery at UTHealth Medical School, in addition to the 21 residents and 11 fellows in the department of Neurology.

During the past year, we welcomed another 10 recruits. Among them is the new chief of neurology Louise McCullough, M.D., Ph.D., an outstanding stroke neurologist who brought with her an extensive cerebrovascular research program. She serves as co-director of the Institute and chair of the department of Neurology. We also welcomed radiation oncologist Angel Blanco, M.D., as director of radiation oncology and stereotactic radiosurgery; interventional pain management specialist Mark J. Burish, M.D., Ph.D., as director of the Will Erwin Headache Research Center; neurosurgeon Sebastian Herrera, M.D.; endovascular surgeons Spiros Blackburn, M.D., and Gary Spiegel, M.D.C.M.; and inpatient neurologists Wamda O. Ahmed, M.D., Vishnu Brahmandam, M.D., Robert J. Brown, M.D., and Jeremy T. Ragland, M.D.

We are fortunate to have terrific teachers and mentors, robust clinical and training programs that allow us to treat the most complicated diseases, cutting-edge research under way in our laboratories and a broad range of clinical trials. Today, the seeds we planted almost a decade ago are growing and ready to achieve full bloom, allowing us to turn to research with new intensity.

With seed funding from generous donors, we established two new research centers: the Will Erwin Headache Research Center and the National Center for Testing Treatments in Chronic Spinal Cord Injury and Traumatic Brain Injury (NCTT). Both centers are unique in their own way – the Will Erwin Center in its focus on cluster headaches and other intractable headaches, and the NCTT in its quest to improve the lives of people who have passed the acute phase of spinal cord injury and traumatic brain injury and are living with a lifelong condition. Through our Innovation and Quality (IQ) Program we're testing novel treatments in clinical trials and transitioning the results of that research to our clinical practice.

We are pleased to share with you the Mischer Neuroscience Institute Clinical Achievements Report for fiscal year 2015, which highlights our ongoing efforts in quality, safety, clinical care and research from July 2014 through June 2015. This year's report also includes a section recognizing the accomplishments of our nurses, who lead improvement by driving quality initiatives.

We're proud of our terrific team of neuroscience providers. As physicians, seeing our patients do well is the main joy of our profession. We're grateful for the roles they play in helping us advance medicine. Please feel free to contact us directly if you would like more information about our services, research and programs.

With best wishes,



A handwritten signature in black ink, appearing to read 'D.H. Kim'.

Dong H. Kim, M.D.

DIRECTOR
MEMORIAL HERMANN MISCHER NEUROSCIENCE INSTITUTE
AT THE TEXAS MEDICAL CENTER

PROFESSOR AND CHAIR
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About the Institute

The Memorial Hermann Mischer Neuroscience Institute's reputation for innovation, high-quality outcomes and the best possible healthcare experiences draws patients from around the world. The Institute's team of clinicians, researchers and educators is nationally recognized for their expertise and consistently ranked by quality benchmarking organizations as a leader in clinical quality and patient safety. Their insights, technological innovations and success at applying research findings at the bedside are transforming the field of neuroscience.

A collaborative effort between Memorial Hermann-Texas Medical Center and UTHealth Medical School,



the Mischer Neuroscience Institute is Houston's undisputed leader in neuroscience care and the foremost neuroscience provider in the southern half of Texas. As the first stroke program in Texas and the only one in the region to meet The Joint Commission's rigorous standards for Comprehensive Stroke Center certification, and one of the few hospitals in the country recognized with the American Heart Association's Get With The Guidelines®—Stroke Gold Plus Achievement Award, the Institute stands among an elite group of providers focused on complex stroke care.

The Institute's comprehensive, integrated approach led to the creation of the Southwest's leading epilepsy

program, a highly ranked neurotrauma program, a cerebrovascular center where affiliated physicians treat more aneurysms and arteriovenous malformations than any other center in the region, an established pediatric neurosurgery program, an unmatched spinal neurosurgery and reconstructive peripheral nerve surgery program, and a Brain Tumor Center where physicians diagnose and treat hundreds of new tumor patients each year. Affiliated physicians are also innovators in the treatment of multiple sclerosis, movement disorders, neurocognitive disorders, neuromuscular diseases and traumatic brain injury. The Institute has extended its continuum of care across the city through the strategic expansion of



ABOUT THE INSTITUTE

Mischer Neuroscience Associates, a citywide network of neurologists, neurosurgeons, neuro-oncologists, interventional pain management specialists and advanced practitioners – and reduced referral wait times by building a new structure for the practice of neurology in the community. These providers analyze quality data and track outcomes as a group, using the same standards employed at the Texas Medical Center to modify clinical practice and ensure exceptional patient experiences.

Through its telemedicine program, the Institute offers patients in outlying communities access to stroke and neurology expertise and opportunities to participate in clinical trials. Fifteen community hospitals in Southeast Texas are now linked to the Institute through remote presence robotic technology. In addition, affiliated physicians are reaching larger numbers of people and engaging them in a powerful way through patient access portals on its website, neuro.memorialhermann.org.

Through the Innovation and Quality (IQ) Program, the Institute's leaders are organizing data to improve physician and service performance, fostering innovative ways to measure quality and track long-term outcomes, and increasing support to enable faculty at UTHealth Medical School to conduct more clinical trials and patient-centered research. The results of these novel treatments are quickly transitioned to clinical practice.

These efforts have led to a strong eight-year growth trend in consumer preference for neuroscience care at Memorial Hermann. During that time, affiliated physicians have reported mortality rates well below the national expected benchmark and have seen a greater than 50 percent reduction in length of stay, despite the increased acuity of the patients they treat.





At a Glance

Physician Team

Staff Physicians	94
Clinical Residents and Fellows	56
Medical Students on Rotation	310
Research Fellows	32
Advanced Practice Providers	17

Inpatient Facilities

Total Neuro Beds	170
Neuro ICU Beds	38
Neuro IMU Beds	12
Neuro Acute Care Beds	73
Stroke Unit Beds	12
Neurorehabilitation Beds	23
Dedicated Operating Rooms	8
EMU Beds – Pediatrics & Adult	12

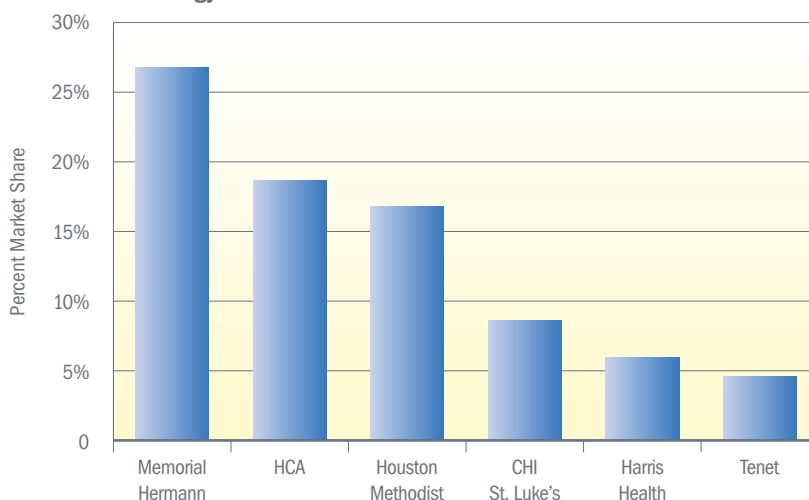
Research

Research Projects in Progress	More than 200
Grants Awarded	\$10 million (Neurology and Neurosurgery)

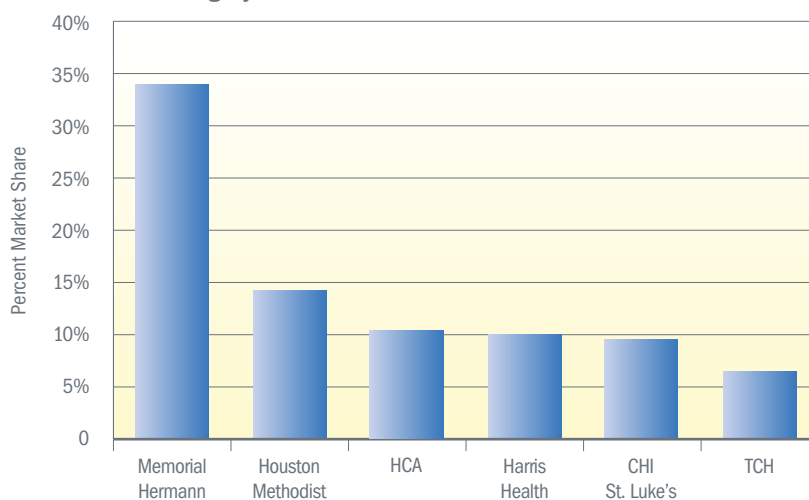
Specialty Equipment includes:

- Leksell Gamma Knife® Perfexion™
- Varian Trilogy Linear Accelerator
- Siemens Artis™ zee (intra-operative angiography suite)
- Robotic SEEG (ROSA)
- RP-7™ Remote Presence System
- 3D C-Arm
- Philips Healthcare endovascular temperature modulation system
- Simultaneous electroencephalography and polysomnography
- Continuous EEG monitoring
- Magnetoencephalography imaging (Magnes Elekta® Neuromag TRIUX)
- MRI capable of advanced spectroscopic and diffusion tensor imaging with tractotomy
- Portable CT machine

Neurology Market Share FY15



Neurosurgery Market Share FY15



Source: Texas Hospital Association Patient Data System (FY2012Q1 – FY2014Q4) provided by Truven Health, formerly Thomson Reuters. Texas Hospital Inpatient Discharge Public Use Data File, [FY2007 Q1– FY2014 Q1] provided by Texas Department of State Health Services, Center for Health Statistics; Q2FY2014 – Q4FY2014 discharges estimated by using historical data by hospital. Excludes Normal Newborns and SNF. Expanded Greater Houston consists of 12 counties: Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, San Jacinto, Waller, Walker and Wharton.

The Patient Experience

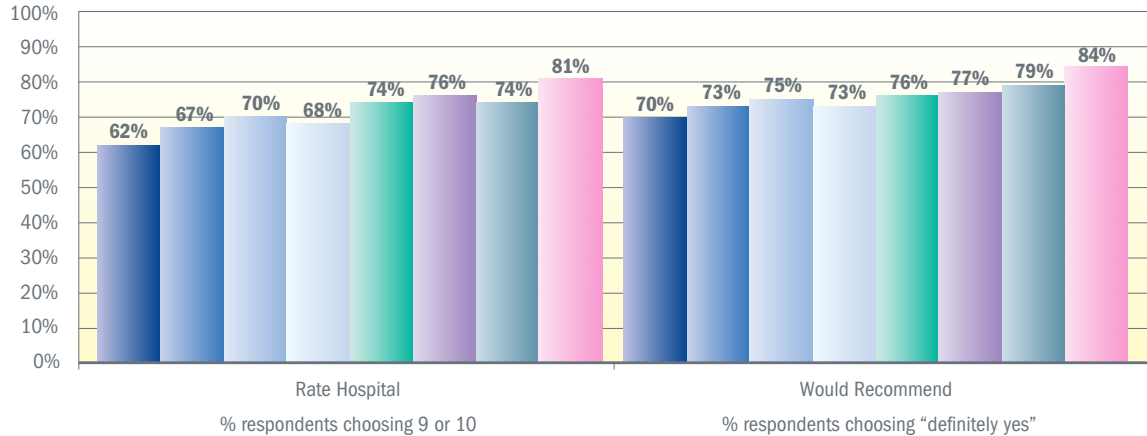
The impact of patient-centered care on clinical outcomes and patient satisfaction is well documented in the medical literature. As institutions across the country struggle to improve outcomes and satisfaction while reducing costs, the Mischer Neuroscience Institute is achieving both goals. The close cooperation of affiliated physicians and an innovative administrative structure allows nurses to spend more time coordinating patient care, which has led to an upward trend in patient satisfaction over the last eight years. Data gathered by the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey shows consistent improvement in domains considered critical to ensuring a high level of patient satisfaction.

HCAHPS Overall Assessment

Surveys Received FY08-15

Total Survey Respondents per Year:

FY08 = 237 FY09 = 436 FY10 = 609 FY11 = 830 FY12 = 795 FY13 = 671 FY14 = 792 FY15 = 887

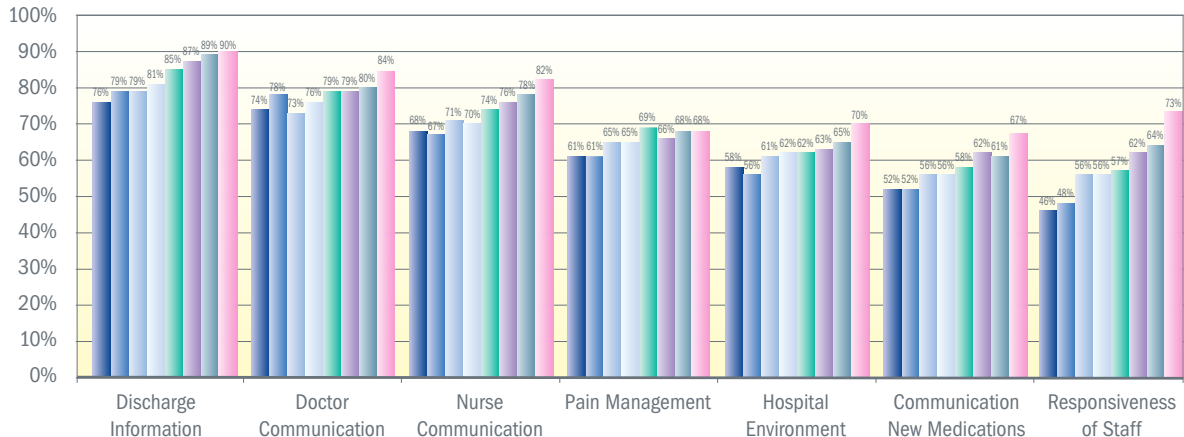


HCAHPS Domains of Care

Surveys Received FY08-15

Respondents choosing "always" or "yes"

FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15



Source: Press Ganey, national hospital survey vendor, for all surveys received from patients discharged from (7 Jones, EMU, 5 Jones, NIMU, Stroke, Spine added as of FY14). HCAHPS scores have not been adjusted to account for a survey mode administration change.

A History of Firsts

- The first stroke program in Texas and the only one in the region to meet The Joint Commission's rigorous standards for the highly coveted Comprehensive Stroke Center certification.
- Site of the first single-center clinical trial for recurrent medulloblastoma, ependymoma and atypical teratoid-rhabdoid tumors using the direct infusion of chemotherapy into the fourth ventricle.
- The first neurosurgery center to offer all advanced modalities of treatment – expert microsurgery, interventional neuroradiology/endovascular surgery and Gamma Knife® radiosurgery – for complex lesions.
- The first hospital in the south-central United States and one of only a few in the country offering intra-arterial chemotherapy for retinoblastoma, the most modern treatment for the disease.
- The first in Texas to use robotic stereo-encephalography (SEEG) for 3-D mapping of epileptic seizures.
- The first in Houston to offer amyloid imaging, a new diagnostic tool that enables physicians to diagnose Alzheimer's disease and will give researchers insights into how they might one day prevent the disorder.
- The first center to conduct a national multicenter trial for hypothermia in head injury.
- The North American leader in studies of primary progressive multiple sclerosis and the most active center in Texas in the conduct of organized clinical trials of new therapies for MS.
- The first facility in Houston and one of the first in the United States to test the clot-dissolving drug tPA for acute stroke.
- The first center in Houston to test and prove the efficacy of three disparate treatments for stroke prevention: carotid surgery; administration of antiplatelet drugs, including aspirin; and patent foramen ovale closure.
- The first stroke center in Houston and one of the first dedicated stroke programs in the world.
- One of the few hospitals in the country recognized with the American Heart Association's Get With The Guidelines®—Stroke Gold Plus Achievement Award.
- One of the first centers in the nation to offer MR-guided laser interstitial thermal therapy (MRgLITT) using the Visualase® system for the treatment of well-delineated focal epilepsies.
- The first center in the region to use the NeuroPace® RNS® System, a new FDA-approved technique for responsive neurostimulation to treat adults with medication-resistant epilepsy.
- The Mischer Neuroscience Institute brought the first clinical magnetoencephalography (MEG) sensor to Houston and has updated the technology to the Elekta Neuromag® TRIUX.
- The Institute houses one of only a few adult and pediatric inpatient Epilepsy Monitoring Units in the country with the unique capability of simultaneously performing electroencephalography and polysomnography.
- TIRR Memorial Hermann is one of only 16 Traumatic Brain Injury (TBI) Model Systems funded by the National Institute on Disability and Rehabilitation Research. TBI Model Systems are national leaders in TBI-related care and research.
- TIRR Memorial Hermann is the only hospital in Houston – and one of only seven designated centers in the nation – in the Christopher & Dana Reeve Foundation NeuroRecovery Network.
- The first in the region to inject human central nervous system stem cells into the spines of spinal cord injury (SCI) patients.





DAVID I. SANDBERG M.D.
PEDIATRIC NEUROSURGERY

In Full Bloom: Mischer Neuroscience Institute Approaches Maturity

Growth continues to be a focus for the Mischer Neuroscience Institute. Through a long standing commitment to providing quality care to patients, the Institute has become the largest and most comprehensive neuroscience provider in the region. Targeted recruitment of expert faculty, dedication to quality initiatives, expansion of the Institute's critical care services across the city, and innovative research have made this growth possible.

The Institute was established in 2006 with a gift from Houston businessman and philanthropist Walt Mischer and his family. The following year, neurosurgeon Dong Kim, M.D., was recruited from Harvard to lead the new Institute, which had a combined neurosurgery and neurology market share of 12 percent in the nation's fourth largest city. Today, thanks to a visionary growth strategy supported by a solid clinical infrastructure, the Institute's market share has more than doubled to 28 percent.

The growth in market share has come in part through the addition of new clinical and academic programs, the recruitment of more than 80 nationally recognized faculty, and the creation of Mischer Neuroscience Associates (MNA) as the Institute's arm in the community. Today, Mischer Neuroscience Institute comprises a

“The lines of communication we've established between the two specialties allow neurologists to fast-track patients who need neurosurgical care. By working back and forth between neurology and neurosurgery, we're providing comprehensive neuroscience care in a much more streamlined fashion.”

— Paul Boone, M.D.

comprehensive team of neuroscience physicians, including neurosurgeons, neurologists, critical care physicians, neuro-oncologists, radiation oncologists and pain management physicians, with a large clinical practice stretching across the city.

To oversee this broad scope of practice, leaders have been assigned to set goals and provide direction. They include neurosurgeon Paul Boone, M.D., who directs MNA's West Market Division; neurosurgeon Geoffrey Zubay, M.D., FACS, director of MNA's North Market Division; neurologist Reza Sadeghi, M.D., in

the South Market; Kiwon Lee, M.D., FACP, FAHA, FCCM, over the Central Market and inpatient critical care/neurology; Daniel H. Kim, M.D., FACS, FAANS, over Spine and Pain Management; Kim Monday, M.D., over Outpatient Neurology; David Sandberg, M.D., FACS, FAAP, over Pediatric Neuroscience; Arthur Day, M.D., over Cerebrovascular; and Nitin Tandon, M.D., over Research and Innovation.

As director of MNA's West Market Division, which includes clinics in Memorial City, Katy and Cypress, Dr. Boone oversees a collaborative, multidisciplinary team. “We've put together a collegial group of neuroscience providers that allows us to offer our patients great continuity of care at a level of quality previously available only in the Texas



Medical Center,” he says. “In the process we reduced patient wait times for neurology – a long-standing problem. The lines of communication we’ve established between the two specialties allow neurologists to fast-track patients who need neurosurgical care. By working back and forth between neurology and neurosurgery, we’re providing comprehensive neuroscience care in a much more streamlined fashion.”

Community practices tend to be inundated with the work involved with scheduling patients, filing insurance forms, reviewing test results and following up, and important aspects of care like tracking quality, safety and performance improvement are not always top of mind. “Physicians in the community run busy practices and don’t always have time to focus on quality metrics

as much as they would like,” says Dr. Boone, a clinical assistant professor in the Vivian L. Smith Department of Neurosurgery at UTHealth Medical School. “We all believe we’re providing superior care, but if we rely on our own self-assessments, there may be surprises when we see the actual data collected by government agencies and others who make it available on the Internet.”

MNA set a goal of applying the same standards used at the Mischer Neuroscience Institute to their suburban neighborhood practices. “Today we’re tracking mortality, surgical site infections, length of stay, patient satisfaction and other data as a group, and using it to modify our clinical practice to ensure that we deliver best-practices care,” says Dr. Geoffrey Zubay, who heads MNA’s North Market Division with practices in northeast Houston and

FEATURE

The Woodlands. “We sit down in quarterly meetings to address any issues that need resolution. By proactively looking at our own data and continuously improving our practice, we stay ahead of the curve.”

Dr. Zubay is pleased to bring high-quality care to even more patients through the expansion of the North Market. At the end of 2015, MNA-The Woodlands broke ground on a neuroscience center that will put neurologists, neurosurgeons and supporting subspecialties under the same roof. The 25,000-square-foot facility is expected to open in 2017.

“We’re becoming the critical care institution for our community, caring for people with more acute neurological conditions,” says Dr. Zubay, a clinical assistant professor of neurosurgery. “In response to population growth in The Woodlands, we expect to expand our services very quickly.”

MNA’s critical care plans for the future include the addition of neurocritical care specialists across the city. The team recently recruited three neurointensivists – Wamda O. Ahmed, M.D.; Robert J. Brown, M.D.; and Jeremy T. Ragland, M.D., who are rotating through the Neurointensive Care Units at Memorial Hermann Memorial City Medical Center, Memorial Hermann Greater Heights Hospital and Memorial Hermann Southwest Hospital, as well as at the Mischer Neuroscience Institute.

“Our ultimate goal is to provide full-time neurocritical care coverage at these locations by replicating what we’ve accomplished at the Mischer Neuroscience Institute,” says Dr. Kiwon Lee, who is director of neurocritical care at the Institute, vice chair for critical care in the Vivian L. Smith Department of Neurosurgery, vice chair for clinical affairs in the department of Neurology and an associate professor of neurology and neurosurgery



Endovascular Program Extends Across the Region

As part of its outreach across the region, Memorial Hermann Health System has made a \$3.5 million investment in the expansion of neuroendovascular capabilities to hospitals outside the Texas Medical Center.

“Our expansion plan was predicated on recruitment – finding the right physicians and then making sure we have the right equipment in place,” says Amanda Spielman, senior vice president for neuroscience at Memorial Hermann Health System. “We chose Memorial Hermann Memorial City Medical Center and Memorial Hermann The Woodlands Hospital – Memorial City because it’s a large hospital with enormous capabilities in the rapidly growing west side of town, and The Woodlands because of its great distance from the Texas Medical Center. For people living in The Woodlands, coming downtown for health care can be a great inconvenience.”

The result is a multicenter, coordinated neuroendovascular program focused on getting the right patients to the right hospital, depending on their needs. Spiros Blackburn, M.D., who specializes in cerebrovascular, skull base and endovascular neurosurgery, was recruited to practice at MNA-Memorial City and MNA-Texas Medical Center. P. Roc Chen, M.D., who joined the Mischer Neuroscience Institute in 2007 and has expertise in the treatment of brain aneurysms, arteriovenous malformations, carotid disease, acoustic neuroma and skull base tumors, has extended his endovascular practice to MNA-Memorial City.

Memorial Hermann’s investment also supported the recruitment of Gary Spiegel, M.D.C.M., at MNA-The Woodlands and MNA-Texas Medical Center. Fellowship trained in surgical neuroangiography and diagnostic neuroradiology, Dr. Spiegel specializes in the full scope of pediatric and adult endovascular neurosurgical therapies



as well as neurointerventional procedures for spine, head and neck conditions, including endovascular treatments for brain aneurysms, arteriovenous malformations and stroke. Mark Dannenbaum, M.D., who specializes in cerebrovascular and neuroendovascular neurosurgery, skull base neurosurgery, and cerebrovascular open micro-neurosurgery, has extended his practice beyond the Texas Medical Center to The Woodlands to support the endovascular program in the North Market. Neurologist Vishnu Brahmandam, M.D., was recruited to provide inpatient care at the hospital.

“People who live in West Houston or North Houston will no longer have to drive to the Texas Medical Center for certain neuroendovascular procedures,” Spielman says. “Those and other high-level services are now available at MNA practices in Memorial City and The Woodlands. To arrive at this point, we created a new model that focused on developing our neuroscience service line in the best way to serve the city, rather than making decisions based on requests for new services at specific hospitals.”



FEATURE

at UTHealth Medical School. “Numerous studies have shown that patients have better outcomes when they receive care in a dedicated neurocritical care unit staffed by specially trained physicians and nurses. The system-wide expansion of neurological emergency and critical care services will facilitate triage and transfer to the appropriate hospital within the network, which will also lead to better outcomes.”

With the citywide infrastructure in place, Dr. Dong Kim has turned more of his focus to the discovery of new knowledge that will change the face of patient care. “We’re thinking much bigger about our future than ever before, especially in terms of research,” says Amanda Spielman, senior vice president for neuroscience at Memorial Hermann Health System.

Clinical research is crucial to optimizing care and providing patients with state-of-the-art treatment options. Under Dr. Kim’s leadership, physicians affiliated with the Mischer Neuroscience Institute are melding research and clinical practice. Patients are evaluated, and those who meet qualifying criteria are invited to participate in innovative research studies. In addition, neuroscience patients are offered the opportunity to participate in research by consenting to allow their tissue samples to be banked in the Institute’s Neuroscience Research Repository (NRR) for current and future research.

“We’ve found it to be incredibly beneficial to have patients collaborate with us in our research endeavors through programs like the NRR, which improves the care of future patients as well as their own,” Dr. Kim says. “And we continue this collaboration through the Innovation and Quality (IQ) Program, where researchers are testing novel treatments in clinical trials and transitioning the results of that research to clinical practice. As the IQ Program expands, we will



design even more trials to help neuroscience patients reach their desired functional potential.”

Through two new research centers created in 2015 – The Will Erwin Headache Research Center and the National Center for Testing Treatments in Chronic Spinal Cord Injury and Traumatic Brain Injury – leadership at the Institute has committed to investment in discovery in two areas that affect Americans profoundly. Recruiting physicians who spend 75 percent of their time focused on research is a new direction for the Mischer Neuroscience Institute.

“We are constantly asking questions and modifying our tools to create new research infrastructures,” Dr. Kim says. “We can now track a range of outcomes across various subsets of our patient population. We’re creating a rich data source that includes long-term outcomes and enables us to identify the best interventions for a particular condition. We can tie that data to decisions about future research, enabling us to positively impact patient outcomes throughout the timeline of patient care.”

Connecting the Dots Between Clinics and Hospitals Improves the Patient Experience

For the past two years, professional staff members at the Memorial Hermann Mischer Neuroscience Institute at the Texas Medical Center and Mischer Neuroscience Associates (MNA), its clinical extension in the community, have worked together to provide a consistent experience for patients from the clinic to the hospital and back to the clinic. The result: a dramatic improvement in Press Ganey patient satisfaction scores at MNA's citywide clinics and in HCAHPS scores at the Institute.

"We've created a holistic culture at our clinics in which everyone is held accountable for patient satisfaction, from the front desk staff to the medical assistants and even to the back-office staff, who generally don't see patients," says Amanda Spielman, senior vice president for neuroscience at Memorial Hermann Health System.

"We're very aware that our patients would rather not be in a neuroscience office, so we've worked to make their experience as pleasant as possible. If there's even a small decline in our patient satisfaction scores, we respond immediately. We stay focused on this every single day."

With their sights set on attaining a distinguished ranking within the Memorial Hermann Health System, Spielman and her team developed a program of education, information and training to ensure that staff members understand each component of Press Ganey and HCAHPS surveys and what patients expect of their healthcare experience. New employees receive training on how to dress for a professional appearance, how to welcome patients and how to keep them informed during their office visit. To help set expectations, they distribute information to patients both in print and in emails, explaining how the clinic visit will work and how long the appointment should take. In the rare event that patients have to wait, a staff member explains why, offers a snack and asks if anything will make them more comfortable during their visit.

As an added incentive, Spielman also developed a bonus plan. "Clinic employees who excel have the opportunity to receive up to 7 percent of their annual salary increase as a year-end bonus, with 3.5 percent tied to overall patient satisfaction scores and 3.5 percent based on various operations and quality metrics in their specific work area,"





she says. “Memorial Hermann Health System’s goal is the 65th percentile in Press Ganey scores. To earn a bonus, staff members in a particular area must achieve the 75th percentile or higher.”

Emily Paisley manages the front office at Mischer Neuroscience Associates-Texas Medical Center and also oversees the patient experience at MNA clinics across the city. “Because the Texas Medical Center is our largest clinic and the one we first focused on improving, it sets the standard for the other 14 clinics across the city,” Paisley says. “Staff members open

doors for patients, look them in the eye and smile when they greet them. When patients arrive, they find a clean, professional environment with flowers at the front desk.”

Staff hired to work at other sites spend time in training at the Texas Medical Center clinic. Paisley meets with physicians and new clinic managers to ensure that they understand the Mischer Neuroscience vision for the patient experience. If a particular clinic’s patient satisfaction scores reflect even a slight decline, she spends time reeducating staff members.



The focus on the patient experience at the MNA clinics has paid off. Since December 2013, the clinics have reported Press Ganey scores above the 75th percentile. For the Memorial Hermann Health System, the 67th to 89th percentile is target, and attainment of the 90th to 99th percentile is considered distinguished. For the first three months of 2015, MNA clinic scores were in the 91st percentile for a distinguished ranking. The team closed the fiscal year in the 83rd percentile across all MNA clinics, a dramatic increase over past scores.

“We’re very aware that our patients would rather not be in a neuroscience office, so we’ve worked to make their experience as pleasant as possible. If there’s even a small decline in our patient satisfaction scores, we respond immediately. We stay focused on this every single day.”

– Amanda Spielman

they’re in the hospital, it helps make the experience less frightening. Information about patients flows back and forth between the hospital and clinic. If a patient and family are particularly anxious about surgery, that information goes to the hospital staff. If a patient has pain after surgery, that knowledge goes back to the clinic staff.”

In the 2015 fiscal year rollup of HCAHPS patient satisfaction scores at Memorial Hermann-Texas Medical Center, the neuroscience service line led the hospital at the 76th percentile, more than 25 points

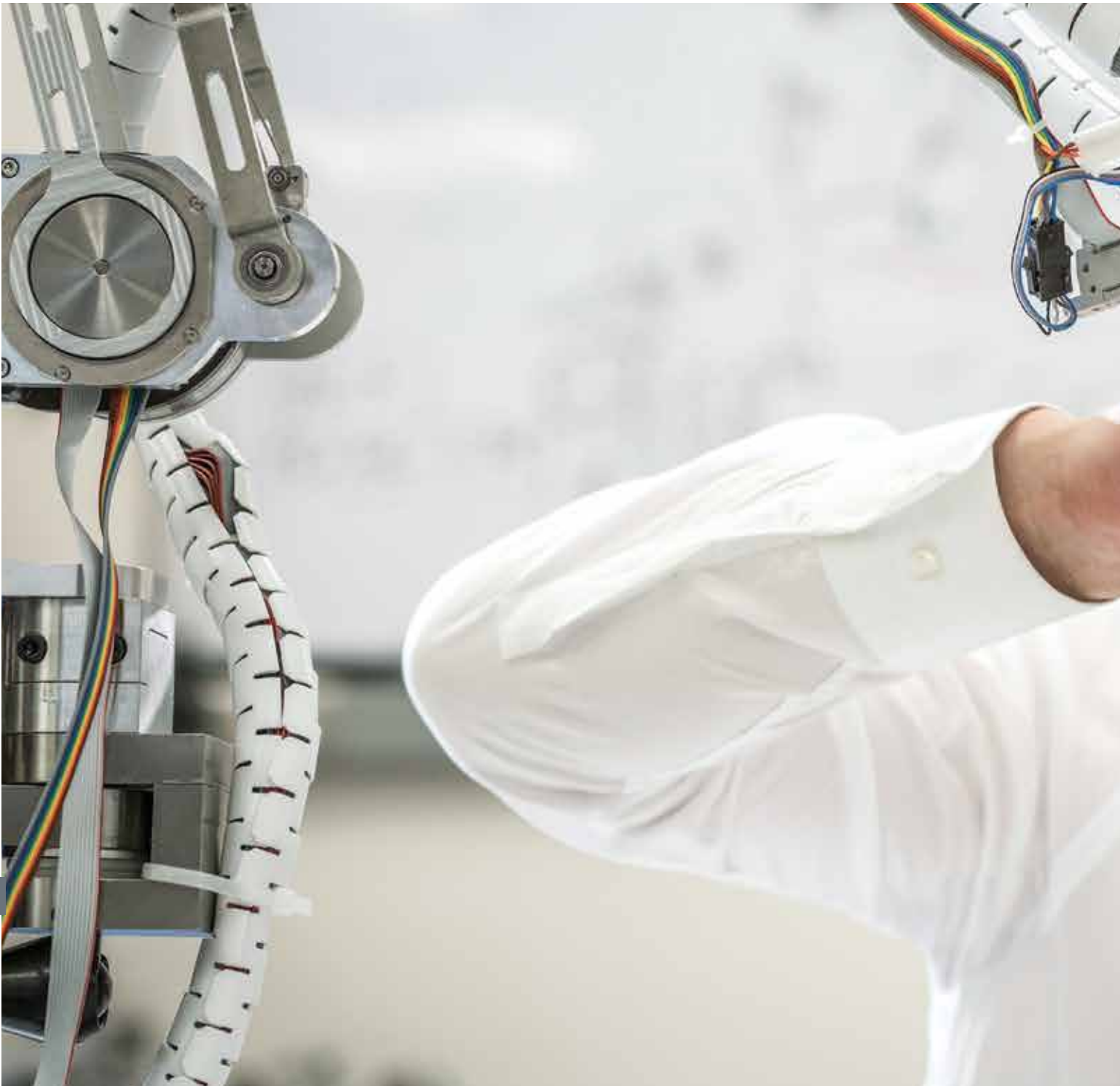
higher than the previous year. In the first quarter of the 2016 fiscal year, neuroscience moved up to lead the hospital at the 86th percentile.

“All this has occurred because we’ve kept our eye on the little things that are important to a good patient experience,” Spielman says. “We’re very clear about our service standards and expectations when we interview and very careful when we hire. We’ve made everyone aware of the components of Press Ganey and HCAHPS and have held people accountable. It took us nearly two years to change the culture, and we’ve done it. The attitude toward patients used to be ‘You’re lucky to be here.’ Now it’s ‘We’re lucky we have you.’”

To ensure coordination and sharing of information as patients move from the clinics to the hospital, Spielman and Nicole Harrison, RN, administrative director of nursing for the Mischer Neuroscience Institute, formed a hospital/clinic coordinating committee. “We discuss anything we see or hear that could make the patient experience less than ideal and find ways to address the issues,” Harrison says. “Those of us on the hospital side don’t know what patients experience in the clinic, so we created a rotating schedule that allows nurses to spend a couple of hours in the clinic. We want our staff to understand the entire patient experience and the impact they have on patients’ lives.”

To help ensure a seamless experience, neuroscience navigators see patients and families in the clinic and also visit during their hospitalization. “We’re continually asking ourselves how we can streamline the experience with the patient in mind,” Spielman says. “I want patients to know that we’re all part of one neuroscience team, working together. If they see a familiar face from the clinic while

Research Update





Learning How the Brain Processes Language

The National Science Foundation (NSF) has awarded a \$1.02 million grant to scientists at Rice University and UTHealth Medical School to study how the brain processes language. The collaborative research may one day help people who lose the ability to communicate.

The grant is part of a \$13.1 million initiative announced by the NSF last August to support integrative, fundamental research for the federal Brain Initiative introduced by President Barack Obama in 2013. The funds will support the analysis of data from intracranial recordings in patients with epilepsy who undergo brain surgery at Memorial Hermann Mischer Neuroscience Institute at the Texas Medical Center.

A language team assembled by Nitin Tandon, M.D., a professor in the Vivian L. Smith Department of Neurosurgery at UTHealth Medical School, includes Rice University electrical and computer engineers Behnaam Aazhang, Ph.D., and Aydin Babakhani, Ph.D. The long-term goal is to design and prototype wireless, inductively charged implants that could enable neurosurgeons like Dr. Tandon to help patients to communicate through a computer interface.

“The human vocabulary is large, yet we are able to select the most appropriate words at very high speeds

and assemble them in a way that conveys meaning,” Dr. Tandon says. “How we do so is not at all understood.” The laboratory teams of Dr. Aazhang, Dr. Tandon and Dr. Babakhani will first collect and analyze data from patients under Dr. Tandon’s care who volunteer for the study. As director of epilepsy surgery at the Mischer Neuroscience

Institute, Dr. Tandon has performed hundreds of surgeries to implant electrodes in patients with epilepsy to monitor and treat their conditions. “While our patients are in the hospital waiting for seizures to occur so we can localize their epilepsy, we ask them to participate in a variety of language experiments so we can study how brain regions are engaged in this process,” he says.

Electrodes that monitor signals produced by neurons provide only coarse data from a limited region of the brain and require connections that pass through the skull. By the end of the three-year project, the team hopes to develop a wireless implant

prototype that will transmit data from hundreds of deep-brain and subsurface electrodes.

“People often ask, ‘What does this part of the brain do? What does that part do?’” Dr. Tandon says. “But nothing in the brain does anything by itself. The parts that can load an abstract concept into a word and then tell your mouth to move are not all in one spot. And they have

“People often ask, ‘What does this part of the brain do? What does that part do?’ But nothing in the brain does anything by itself. The parts that can load an abstract concept into a word and then tell your mouth to move are not all in one spot. And they have to communicate with each other. We want the ability to intercept and translate those signals.”

– Nitin Tandon, M.D.



to communicate with each other. We want the ability to intercept and translate those signals.”

While data collection will be limited to a relative few of the brain’s 100 billion neurons, it will be enough to greatly advance knowledge of how they communicate. Data from Dr. Tandon’s volunteers will also be used to build a large database of language-processing networks. “We can get only a small sample from each person, but if we get hundreds of people together, we will gather enough data from all parts of the brain to make a composite map – an atlas – of brain function during speech production,” he says. The researchers hope to learn what regions cause other regions to generate speech and will use tools developed for network analysis in other fields to understand the interactions between these regions.

Tandon observes that as many as 100,000 Americans suffer brain injuries that impair speech each year. “We hope one day to be able to provide wireless brain implants that will help these patients communicate via computer

programs,” he says. “Using the incomplete language network that remains, these prosthetics would reconstruct speech and allow folks to communicate their basic needs and emotions. A computer would try to understand what the person wants to say and create a response. That individual would then agree or disagree with the response.”

The first step will be the low-power prototype to acquire neural signals and stimulate neurons. The Rice team has extensive experience designing, building and testing integrated analog/radio frequency chips for signal acquisition and stimulation.

Tandon says Rice, UTHealth and Baylor College of Medicine scientists have worked closely in recent years to form neural engineering collaborations. “This grant is part of a greater effort on our part to create in the Texas Medical Center the best place to develop neural devices,” he says. “We have a long track record of innovation in cardiology and cardiothoracic surgery. It’s now time for this to happen in neuroscience.”

The Will Erwin Headache Research Center Opens at the Mischer Neuroscience Institute



The Will Erwin Headache Research Foundation has teamed up with the Mischer Neuroscience Institute and UTHealth Medical School to fulfill its mission of bringing relief to the millions of people around the globe afflicted with debilitating headaches and facial pain syndromes, including migraines and cluster headaches. The foundation's \$20 million commitment – \$2 million per year over 10 years – provided the initial funding to establish the Will Erwin Headache Research Center at the Vivian L. Smith Department of Neurosurgery.

The Will Erwin Headache Research Foundation was launched by Houston native Jimmy Erwin in memory of his son Will, who suffered from both migraines and cluster headaches. "This is a condition that impacts the lives of people all over the world," says Erwin, president of the foundation. "It's time for an organization to step up and fix the problem and that's what we intend to do."

Although debilitating headaches affect 12 percent of the American population, research directed toward finding a cure is significantly underfunded. In 2014, the National Institutes of Health earmarked \$45 million of annual funding for headache research, which represents only .03 percent of the total \$146 billion allocated to medical research. Within that small amount of funding, cluster headache research is especially undersupported. Through its global fundraising efforts, the Will Erwin Headache Research Foundation aims to dramatically increase funding for the study of neurological disorders and, more importantly, to bring an end to the pain they cause.

"The new Will Erwin Headache Research Center has recruited a group of experts dedicated to the study of cluster headaches and conditions arising from the trigeminal nerve," says Dong Kim, M.D., director of Mischer Neuroscience Institute and professor and chair of the Vivian L. Smith Department of Neurosurgery at UTHealth

Medical School. “The group will develop a national consortium of centers to identify patients with cluster headache and other debilitating types of headaches. Because of the relatively small number of patients in the Greater Houston area, a collaborative consortium is the best way to make progress in understanding and treating the disorders. The nationwide group will also work to educate other caregivers to improve diagnosis and treatment.”

The new Center is led by Mark Burish, M.D., Ph.D., a neurologist who is fellowship trained in interventional pain management. A cum laude graduate of Princeton University, Dr. Burish received his M.D./Ph.D. in the Vanderbilt Medical Scientist Training Program at Vanderbilt University School of Medicine and completed his residency in neurology at the University of California at San Francisco, where he was co-chief resident of the UCSF Moffitt-Long Service and was inducted into Alpha Omega Alpha Honor Medical Society. He completed his fellowship in interventional pain management in the department of Anesthesiology at UCSF.

“Cluster headache is a debilitating disease,” says Dr. Burish, an assistant professor in the Vivian L. Smith Department of Neurosurgery. “They can occur at any age but are most common in young adults, at a time when people are in school or just beginning their careers. They tend to run in families and affect more males than females, but to date, no one gene related to the disorder

has been identified. We hope to make progress toward finding the cause and a cure.”

Physicians and researchers working with the Will Erwin Center include Pramod Dash, Ph.D., professor and Nina and Michael Zilkha Distinguished

Chair in Neurodegenerative Disease Research in the department of Neurobiology and Anatomy; neurosurgeon Daniel Kim, M.D., FACS, FAANS, professor of neurosurgery; neurosurgeon Albert Fenoy, M.D., assistant professor of neurosurgery; neuroradiologist Kaye Westmark, M.D.; interventional pain management specialist Nadya Dhanani, M.D., assistant professor of neurosurgery; interventional pain management specialist G. Silky Patel, M.D., clinical assistant professor of neurosurgery; radiation oncologist Angel Blanco, M.D.; researcher Georgene Hergenroeder, B.S.N., M.H.A., RN, CCRC, director

of the Innovation and Quality Program who also directs a research lab; and genetic counselor Krista Qualmann, M.S.

The Will Erwin Headache Research Foundation is a component fund of the Greater Houston Community Foundation and is a registered 501(c)(3) organization. Donations can be made at www.cureheadaches.org.

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Mischer Neuroscience Institute Launches the National Center for Testing Treatments in Chronic Spinal Cord Injury and Traumatic Brain Injury

As part of its growing research program, the Mischer Neuroscience Institute recently established the National Center for Testing Treatments in Chronic Spinal Cord Injury and Traumatic Brain Injury (NCTT). The new Center is unique in its focus on research to improve the lives of people who have passed the acute phase of spinal cord injury (SCI) and are living with the injury as a lifelong condition.

“While other national organizations focus their investigations on spinal cord injury and traumatic brain injury in the acute phase of treatment, the NCTT will focus on clinical trials for patients with chronic injury,” says Dong Kim, M.D., director of the Mischer Neuroscience Institute and professor and chair of the Vivian L. Smith Department of Neurosurgery at UTHealth Medical School. “By freeing ourselves from the time pressure of identification and enrollment of patients in the acute period, we can accurately identify people with a similar experience of trauma, similar injuries and similar deficits. Once we’ve generated a database of patients whose recovery has plateaued and whose deficits are stable, we’ll be in a position to test treatment

“Once we’ve generated a database of patients whose recovery has plateaued and whose deficits are stable, we’ll be in a position to test treatment ideas systematically, one at a time in experimentally controlled circumstances. We believe our approach has the best chance of rapidly impacting patients’ lives.”

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Seed money for the Center is provided by the Staman Ogilvie Fund for Spinal Cord Injury, Recovery, Rehabilitation and Research, created through the Memorial Hermann Foundation to fund innovative research to assist people whose lives have been disrupted by spinal cord injury, brain injury or neurological disorders. Ogilvie created the fund after

suffering a spinal cord injury in a cycling accident in June 2009, and has since led a crusade to generate practical solutions to increase movement and provide hope for people with neurological disabilities.

“The Mischer Neuroscience Institute has a strong group of scientists doing substantial lab research in spinal cord injury and traumatic brain injury, and we’re also aware that great research is being done in other places around the country,” Ogilvie says. “The NCTT will ensure that we have a front-row seat for the best work being done by allowing

us to actively participate in trials of potentially healing therapies. In addition to testing the hypotheses of our own researchers, we'll be able to corroborate the discoveries of others by replicating them in the lab. Our great hope is to bring about significant functional improvement after SCI."

Researchers at the NCTT are currently working with the Houston chapter of the National Spinal Cord Injury Association to create a database of chronic SCI and TBI patients in the Greater Houston area. "The database will include all of us in the area who are willing to be considered for trials for which we as individuals are particularly well suited based on the nature of our injury, its duration and our lifestyles," Ogilvie says. "Once we've accomplished that, the NCTT will be in a position to clinically test its own discoveries and share the database with other researchers who want to replicate successes they've shown in their own labs. Ultimately, we'd like to find three or four other groups around the country to join us in creating their own geographic databases. There is great power in a national cross-referenced database that will allow researchers to connect with willing study participants who have been carefully selected as appropriate for a specific trial." Researchers and rehabilitation specialists working with the NCTT include scientific advisor Pramod Dash, Ph.D., professor and Nina and Michael Zilkha Distinguished Chair in Neurodegenerative Disease Research in the department of Neurobiology and Anatomy; researcher Georgene Hergenroeder, B.S.N., M.H.A., RN, CCRC, director of the Innovation and Quality Program who also directs a research lab; and Rafferty Laredo, OTR, M.A., ATP, executive director of the Houston chapter of the National Spinal Cord Injury Association.

The NCTT's novel approach will complement acute intervention networks like the North American Clinical Trials Network (NACTN), of which the Mischer Neuroscience Institute is a member, and the Neurological Emergencies



Treatment Trials (NETT), funded by the National Institutes of Health. Founded in 2004 with support from the Christopher & Dana Reeve Foundation, the NACTN was initiated as a registry that would record the natural progression of acute SCI with the immediate goal of identifying and testing potential therapies and putting them to clinical use. To date, the network has tested only one agent, riluzole, in a safety study of 36 participants. The NETT recently completed a study in acute TBI showing that progesterone was safe but provided no significant benefit to patients, despite success in numerous experiments using animal models.

Dr. Kim expects the NCTT's plan to study chronic patients to be more cost effective by eliminating the need for on-call teams required in studies of acute SCI and TBI. "Patients can be enrolled in a small number of centers located around the country, instead of 20 or more as in NACTN and NETT," he says. "A few researchers working systematically will be able to identify and classify many patients, allowing us to perform studies to better characterize and understand these patients. This is a huge, long-term endeavor to commit energy, talent and research dollars to help people with SCI and TBI recover and participate more fully in life."

The World's Smallest Surgical Robot

A powerful creative collaboration between researchers in South Korea and the United States has positioned both countries at a new frontier of medicine: tele-robotic microsurgery.

"Imagine a world in which minimally invasive single-port surgery is available anywhere at any time," says Daniel H. Kim, M.D., FACS, FAANS, a professor in the Vivian L. Smith Department of Neurosurgery at UTHealth Medical School and director of spinal and peripheral nerve surgery at Mischer Neuroscience Institute. "In this new world, spina bifida and other fetal defects could be treated safely before birth, and stroke patients living in remote locations would have fast access to the same care available in large cities. That world is within our reach."

Researchers in Houston, at the Mischer Neuroscience Institute and UTHealth Medical School, and at KAIST in South Korea are the frontrunners in an international race to develop the first tele-robotic microsurgical tool – the world's smallest surgical robot. The new system will make robotic surgery possible in any location, performed by surgeons in medical hubs in the United States, South Korea and other countries. The end result: a global healthcare model for advanced care delivered tele-robotically to rural locations and less-developed countries.

The limitations of open surgery led to the development of laparoscopic surgery through four small incisions. From there, physicians developed single-incision surgery, operating through one entry point. The domain of the future is single-port tele-robotic surgery enabling microscopic manipulation beyond the surgeon's skill – anywhere in the world.

“Our miniaturized robot will access sites deep in the body unreachable with other robotic devices. Tele-robotics will enable physicians to treat patients anywhere in the world. This new technology is cost-effective and high impact.”
– Daniel H. Kim, M.D.

"Current medical robot technology is expensive and bulky," Dr. Kim says. "Designed for access through four small incisions, it lacks the small scale and flexibility needed to operate through a single port. Our new miniaturized tele-robotic system for microsurgery, designed in collaboration with KAIST, is small, mobile, versatile and agile – a model for the future of surgery."

The new miniaturized tele-robot allows physicians to move the system's four arms to accommodate the patient and the procedure. Its frame fits on an existing operating table. Instrumentation is jointed – with wrists and elbows that allow additional degrees of motion – and miniaturized to allow for the use of four surgical instruments through a single incision. Unlike current robotic technology, which requires frequent replacement of expensive parts, each instrument may be removed for sterilization and reused. Dr. Kim and his team expect the robot to outperform currently technology in cost, stability and dexterity.



The researchers have taken the miniaturization of technology a step further and developed a steerable micro-robot that can maneuver through small spaces between organs in a snake-like motion. Only 10 millimeters in diameter, this “snake robot” has two tiny graspers, one microsurgical instrument and the world’s smallest lighted camera. The mirco-snake has novel robotic clinical applications for fetal surgery, as well as for spine and cranial surgery.

“Since the 1930s, the first step in the treatment of newborns with spina bifida has been surgery to close the incompletely developed portion of the spinal cord a few days after birth,” Dr. Kim says. “In-utero open and minimally invasive repair are now possible, but both procedures have high morbidity and mortality rates for mother and baby. The microsurgical robot enables precise fetal surgery through a single incision, lowering risk during procedures to repair heart defects, esophageal atresia, spina bifida and other abnormalities.”

Also under development is a steerable tele-robotic microcatheter with life-changing potential for stroke patients worldwide. For those living in remote locations, access to fast care may not be possible. With tele-robotics, an emergency physician in a rural community can access the femoral artery, and a skilled endovascular neurosurgeon working in a tele-robotic hub can manipulate the microcatheter via computer to retrieve the clot.

“Stroke is a time-sensitive emergency,” says Mark Dannenbaum, M.D., a fellowship-trained neurosurgeon with expertise in vascular and endovascular neurosurgery. “Our goal is to design a highly specialized microcatheter – the first of its kind – that can overcome the anatomic limitations of traditional embolectomy and retrieve the

clot with precision. We hope to change the landscape of stroke treatment worldwide through tele-robotics.”

The novel microcatheter uses smart materials – an electroactive polymer that can bend to accommodate anatomy. That same technology can be adapted for minimally invasive spine procedures, brain surgery and other intricate operations.

The researchers have refined their first prototype. Preclinical animal studies began in late 2015, with the first human studies expected by the summer of 2016.

At the heart of this new technology is a desire to improve quality of life and outcomes that connects researchers on two continents. “Through our collaboration with innovative scientists in South Korea, we’re leading the future of surgery,” Dr. Kim says. “Our miniaturized robot will access sites deep in the body unreachable with other robotic devices. Tele-robotics will enable physicians to treat patients anywhere in the world. This new technology is cost-effective and high impact. When tele-robotic hubs are completed, we’ll bring the world something entirely new – a model for truly global health care.”

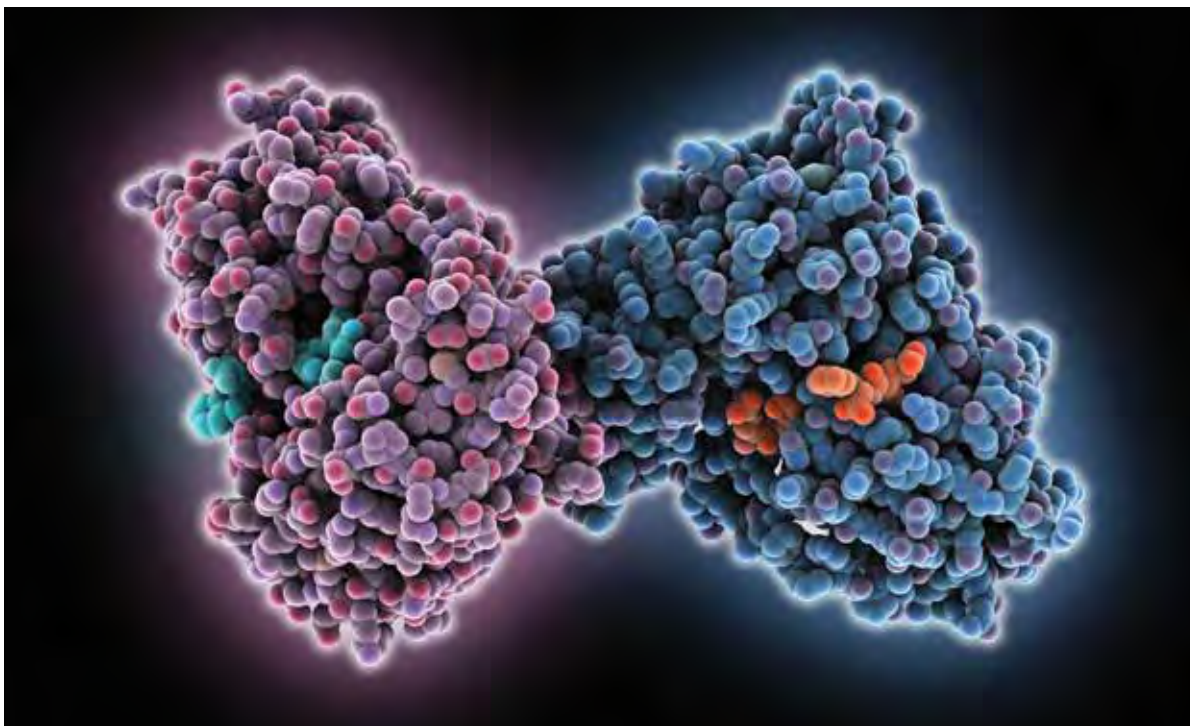
Unraveling the Mysteries of Alzheimer's Disease

Three new studies under way in the laboratory of Claudio Soto, Ph.D., are investigating potential new ways to diagnose and treat Alzheimer's disease (AD). Dr. Soto directs a team of researchers focused on the investigation of the molecular basis of protein misfolding disorders, mainly Alzheimer's disease and prion-related disorders.

"A hallmark event in Alzheimer's disease is the misfolding of the amyloid-beta protein, which then is deposited in the brain in the form of amyloid plaques," says Dr. Soto, a professor in the department of Neurology at UTHealth Medical School. "These plaques, or some

of the precursor misfolded oligomeric particles, are thought to cause neuronal death and synaptic loss resulting finally in dementia."

Over the past 20 years, Dr. Soto has focused his research on understanding the mechanism and factors involved in the conversion of a normal protein into the disease-associated abnormal form that accumulates in the brain to produce some of the most devastating neurodegenerative diseases. "Our studies combine basic science investigations with a permanent effort to translate these discoveries into novel approaches for early diagnosis and treatment," he says.



With a new grant from the National Institutes of Health, Dr. Soto and his team are investigating a blood-based diagnosis for AD. A fast-track combined Phase I and II Small Business Technology Transfer (STTR) project in partnership between Amprion, Inc. and UTHealth Medical School, the project may offer a way to diagnose AD before extensive brain damage and dementia set in.

“For this purpose we’re adapting the protein misfolding cyclic amplification (PMCA) technology invented in our lab for specific and highly sensitive detection of misfolded A β oligomers in human blood,” Dr. Soto says. “A β oligomers may be circulating in the body years, if not decades, before cognitive symptoms arise. We’re hoping the results generated by this project will detect them and lead to the first biochemical test for blood-based diagnosis of AD.”

Dr. Soto is also principal investigator in two studies funded by UTHealth Brain Initiative Awards: “Chimeric Mice Harboring Human Nerve Cells as a Model of Alzheimer’s Disease” and “Traumatic Brain Injury Promotes Alzheimer’s Disease Through Seed Formation.” The first study, conducted in collaboration with Brian Davis, Ph.D., of the Brown Foundation Institute of Molecular Medicine for the Prevention of Human Diseases, aims to develop new models of AD by grafting into the mouse brain human-derived cells from healthy individuals, as well as from AD patients affected by inherited and sporadic forms of the disease. Human nerve cells have been generated in Dr. Soto’s lab by reprogramming adult fibroblasts into induced pluripotent stem cells. They are later converted into different types of neurons.

“Alzheimer’s disease is a leading cause of death in the developed world and currently affects more than 10 million people worldwide. Its treatment is hampered by the lack of early, sensitive and objective laboratory tests. We hope to change that.”

– Dr. Soto, M.D.

“Our working hypothesis is that chimeric mice harboring human nerve cells will reproduce the complete cerebral abnormalities observed in AD patients,” he says.

“As a result, chimeric mice may be more relevant and predictable models of AD and may become great tools to investigate the molecular bases of neurodegenerative

processes. This model may also help us discover new pharmaceutical targets and biomarkers for the much-needed development of new drugs to treat or even prevent the onset of the disease.”

In the second UTHealth Brain Initiative study, Dr. Soto and his team, in collaboration with Pramod Dash, Ph.D., of the Vivian L. Smith Department of Neurosurgery, posit that traumatic brain injury induces the formation of the first misfolded oligomeric seeds composed of either or both amyloid-beta and

tau protein, which then spread the pathology throughout the brain by a prion-like mechanism, resulting in the development of AD. They will test the theory in various transgenic mice models.

The research has the potential to change the face of diagnosis and treatment of Alzheimer’s disease. “Alzheimer’s disease is the most common form of dementia in late life, and at present it does not have a cure or an effective treatment,” Dr. Soto says. “It is a leading cause of death in the developed world and currently affects more than 10 million people worldwide. Its treatment is hampered by the lack of early, sensitive and objective laboratory tests. We hope to change that.”

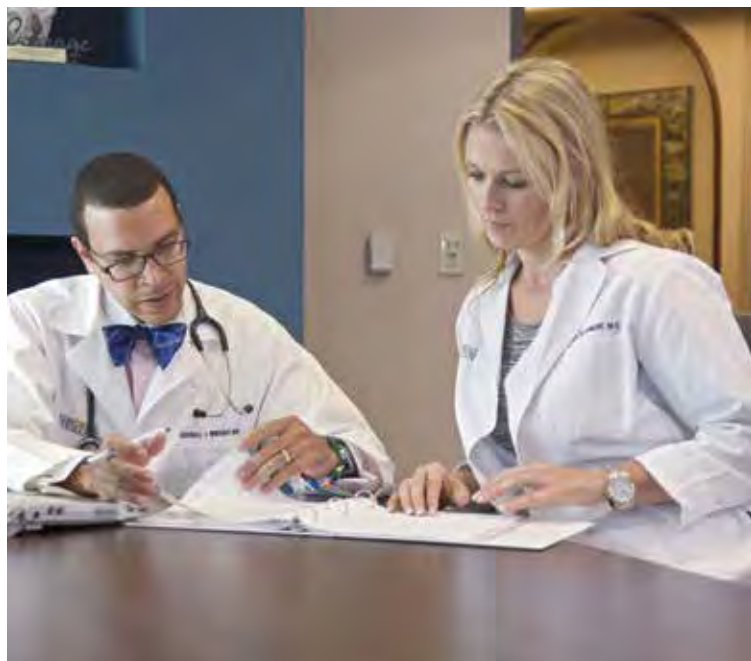
Tracking Outcomes Over Time to Improve Quality

As healthcare reform moves the focus of medicine toward keeping patients healthy, physicians and staff at the Mischer Neuroscience Institute and Mischer Neuroscience Associates, the Institute's arm in the community, are tracking outcomes prospectively to ensure that the care patients receive really is improving the quality of their lives.

The effort to record patient outcomes over the long haul is led by biostatistician Miriam Morales, director of strategic analytics at Mischer Neuroscience Associates (MNA). "We're assessing our patients' perceptions of their status at three, six and 12 months following treatment and every year after that using standardized questionnaires accepted by the neurosurgical community for brain and spine patients," Morales says. "The data we're gathering, organizing and analyzing will ultimately improve physician performance based on evidence-based guidelines and lead to better care and patient outcomes."

Patients have easy online access to questionnaires through the Memorial Hermann patient portal, which also allows them to view physician notes, clinic visit summaries and lab results. If they prefer, they may complete the questionnaire at their follow-up clinic visit. Patients who did not have surgery or are no longer seeing their physician in postoperative follow-up are emailed a link to an online questionnaire or mailed a hard copy, based on their preference.

"In this day and age of technology, the patient portal and the email link are easy ways to capture patients' assessments of their quality of life after treatment," she says.



Patient data from the 15 MNA clinics located across Houston are captured in a registry created by Morales, who uses it to track patient encounters with physicians. The registry also logs the results of assessments by patients who are no longer seeing a physician.

"This is not just research for the sake of research," she says. "It's about ensuring that we're providing the right type of intervention to the right patients, and that the intervention is making a difference in quality of life. In medicine, a 30 percent follow-up rate is rare. In our first few months of tracking patients, our follow-up rate is between 60 and 70 percent. By December 2015, we'll have enough data to begin to show our physicians their patients' outcomes over time."

From Bench to Bedside with the Cerebrovascular Research Group

By definition, neurovascular research has a broad reach, spanning neuroscience, clinical neurology, vascular biology, immunology, cerebrovascular diseases and aging. By supporting interdisciplinary collaborative research from each of these areas, the Cerebrovascular Research Group at UTHealth Medical School is developing effective strategies for the diagnosis and treatment of stroke and brain injury, and moving new discoveries quickly from the bench to the bedside.

“A key component of our mission is to design therapeutic intervention strategies that are successful not only in the laboratory but also have real clinical

potential,” says Louise D. McCullough, M.D., Ph.D., professor and chair of the department of Neurology at UTHealth Medical School and the new co-director of the Mischer Neuroscience Institute. “To ensure that these strategies are on track from their inception through application, the Group works closely with the neurology and neurosurgery services at Memorial Hermann-Texas Medical Center, as well as others at the Mischer Neuroscience Institute and The University of Texas Health Science Center at Houston. Targets identified in the lab are validated in clinical samples and translated back to animal models where manipulation in a controlled research environment is possible.”

Programs currently active include the evaluation of mechanisms underlying sex differences in stroke, understanding how social factors such as depression and social isolation impact stroke outcome, pregnancy-associated stroke risk and determining the impact of aging of the immune system on stroke-related cognitive decline.

In the future, Dr. McCullough will make education and mentoring a central theme within the Cerebrovascular Research Group by involving students at the high school, undergraduate, graduate, postgraduate, resident and fellowship level. “We want to give undergraduates opportunities to complete summer research projects or senior honors thesis projects,” she says. “Graduate and M.D./Ph.D. research opportunities also will be available, as will postdoctoral fellowships, resident research projects and opportunities for collaboration for developing faculty.”



The goal is to provide infrastructure that will benefit graduate students and faculty with an interest in translational science and animal models of neurological diseases, specifically in ischemic brain injury, neuroimmunology and aging. Group members want to provide an interdisciplinary environment and scientific and intellectual resources to researchers throughout the Texas Medical Center. “With the exceptionally strong clinical stroke program led by Dr. Sean Savitz, the translational science infrastructure and biorepositories already here at UTHealth and Memorial Hermann, we have a unique and unprecedented opportunity to make an impact on stroke care in the immediate future,” she says.

“A key component of our mission is to design therapeutic intervention strategies that are successful not only in the laboratory but also have real clinical potential.”

– Louise D. McCullough, M.D., Ph.D.

Dr. McCullough is principal investigator of five research studies funded by the National Institute of Neurological Disorders and Stroke (NINDS), including a \$2.2 million study examining chromosomal and hormonal contributions to sex differences in ischemic stroke. “New experimental data has shown that brain cells die differently in males and females, and each sex responds differently to neuroprotective strategies,” she says. “Because stroke is now the No. 1 cause of disability, new treatments are urgently needed.”

She is also principal investigator in a NINDS-funded study of the neuroprotective potential of TGF-beta activated kinase inhibition in acute stroke. The study is testing promising therapies in a variety of animal models before moving them to clinical trials.

“New data from the bench has identified a novel signaling pathway involved in the response to stroke,”

Dr. McCullough says. “We’re testing if inhibition of this pathway is protective in aging in the hope of improving stroke outcomes in older patients.”

Other studies led by the Cerebrovascular Research Group include an investigation of the hypothesis that microchimeric cells home to the site of injury as part of the immune response to stroke, and display a stem cell phenotype with potential to aid in repair, led by Dr. McCullough and funded by NINDS; the potential neuroprotective efficacy of a novel formulation of human inter-alpha inhibitors as a viable treatment for stroke, also led by Dr. McCullough and funded by NINDS; an investigation of the functional role of CaMK signaling in

stroke, led by Jun Li, Ph.D., and funded by an R01 grant from the National Institutes of Health (NIH); a study of the effects of X chromosome-linked proteins on sexual dimorphism in ischemic stroke, led by Fudong Liu, M.D, with funding from the American Heart Association; and a study of how manipulation of the IRF5-IRF4 regulatory axis in microglia/infiltrating leukocytes may help limit ischemic injury and promote tissue repair after stroke, led by Dr. Liu and funded by an R01 grant from the NIH.

Dr. Liu was also recently awarded an R21 grant to examine sex differences in inflammation after neonatal stroke. Finally, the role of an emerging cytokine, macrophage migration inhibitory factor (MIF) levels in depression and post-stroke recovery, is being examined in animal and clinical samples, research led by Venugopal Reddy Venna, Ph.D., with funding from the American Heart Association.



2015 Accolades

Dr. Bob Fayle Named Physician of the Year by the Texas Neurological Society



Neurologist Robert W. Fayle, M.D., has been honored as Physician of the Year by the Texas Neurological Society. The society promotes the interest of patients with neurologic disease by supporting the development

and delivery of quality medical care to these patients.

Board certified in adult neurology and sleep medicine, Dr. Fayle is a past president of the Texas Neurological Society and currently serves as chair of the organization’s Education Committee. He has held multiple leadership positions with Memorial Medical Center in Livingston, Memorial Clinics, the Harris County Medical Society, the Texas Medical Association, the American Academy of Sleep Medicine, the Diagnostic Center Hospital Board of Trustees, the Diagnostic Clinic of Houston Executive Committee and the Park Plaza Hospital Medical Executive Committee.

Dr. Fayle received his medical degree at UTHealth Medical School and completed his residency in neurology at UTHealth-affiliated hospitals in Houston. His research in the field of sleep and stroke, including CPAP compliance and adherence, treatment of insomnia and the role of sleep apnea in diabetic patients, has been published widely.

Dr. Fayle, who is on the medical staff at Memorial Hermann Southeast Hospital, provides neurological consultations and follow-up at the Houston Neurological Institute’s Pasadena and Pearland locations.

Twenty-five Physicians Named Among Houston’s Top Doctors for 2015

Twenty-five physicians affiliated with the Memorial Hermann Mischer Neuroscience Institute at the Texas



Medical Center and UTHealth Medical School have been named to *Houstonia* magazine’s 2015 listing of Top Doctors in Houston. Physicians named to the 2015 list were selected based on nominations

solicited from nearly 16,000 medical professionals practicing in eight counties in the Greater Houston area.

Neurosurgeons included on the list are Peng Roc Chen, M.D.; Arthur L. Day, M.D.; Daniel H. Kim, M.D., Dong Kim, M.D.; and Nitin Tandon, M.D. Pediatric neurosurgeons among the Top Doctors are David I. Sandberg, M.D., and Manish Shah, M.D.

Neurologists on *Houstonia* magazine’s list are Andrew Barreto, M.D.; Suur Biliciler, M.D.; José M. Diaz, M.D.; William G. Irr, M.D.; Giridhar P. Kalamangalam, M.D.; John A. Lincoln, M.D.; Raymond A. Martin, M.D.; Ankit Patel, M.D.; Sean I. Savitz, M.D.; Mya C. Schiess, M.D.; Jeremy D. Slater, M.D.; Sudha S. Tallavajhula, M.D.; and Mary Ellen Vanderlick, M.D.. Pediatric neurologists listed are Ian J. Butler, M.D.; Mary Kay Koenig, M.D.; Jeremy Lankford, M.D.; Pedro Mancias, M.D.; and Gretchen Von Allmen, M.D.

NEWS OF NOTE

Grand Rounds on the Green: 2016 Neurosurgery Symposium



Mark your calendars for a weekend of continuing medical education at Grand Rounds on the Green, to be held Oct. 14-16, 2016, in Sea Island, Georgia. Hosted by the Mischer Neuroscience Institute and UHealth Medical School, Emory University School of Medicine and Washington University School of Medicine, this intimate gathering will be held at The Cloister at Sea Island and its sister hotel The Lodge at Sea Island.

Friday's activities will include a welcome lunch and a four-hour didactic session, with a reception at 7 p.m. and dinner at 8. On Saturday, there will be a didactic

session from 2 to 6 p.m. and a reception and dinner in the evening. The program will end on Sunday with lunch and a wrap-up session.

For more information about the event, visit neuro.memorialhermann.org/cme.

Mischer Neuroscience Institute Hosts 3rd Annual Neuro ICU Symposium

More than 350 physicians, nurses, fellows, residents and medical professionals working in neurology, neurosurgery, critical care, trauma, emergency medicine and anesthesiology attended the Memorial Hermann Mischer Neuroscience Institute's 3rd Annual Neuro ICU Symposium, held at the JW Marriott Houston in March 2015. Participants came from 13 states and Canada.

This year's event, "Cutting-edge Management of Neurological and Neurosurgical Emergencies and Critical Care," focused on how to manage patients optimally using a team approach. Highlights included a one-day comprehensive neurocritical care board examination

review course and interactive sessions – hands-on workshops for invasive multimodality brain monitoring, advanced hemodynamic management, critical care sonography and how to build a physician-nurse team. Emphasis was placed on treating patients early, starting in the emergency room.

A multidisciplinary team of experts in the field of neurocritical care, neurology, neurosurgery, internal medicine and trauma, including physicians affiliated with the Mischer Neuroscience Institute, presented the course. Invited faculty speakers from other institutions were Edward Manno, M.D., chief of neurocritical care, Cerebrovascular Center, Cleveland Clinic and vice president of the Neurocritical Care Society; Dong-Eog Kim, M.D., Ph.D., professor and chairman, department of Neurology and director of molecular imaging and vascular neurology research at Dongkuk University School of Medicine in Seoul, Korea; Gene Sung, M.D., chief, division of Stroke and Neurocritical Care, Keck School of Medicine, University of Southern California, Los Angeles; and Joseph Meltzer, M.D., director, Cardiothoracic Intensive Care Unit and program

director, Anesthesiology Critical Care Medicine Fellowship, David Geffen School of Medicine at UCLA, Los Angeles. Course director and committee chairman was Kiwon Lee, M.D., FACP, FAHA, FCCM, vice chairman of neurosurgery for critical care, chief of the division of Critical Care and director of the Neuroscience and Neurotrauma ICU at the Mischer Neuroscience Institute and an associate professor in the department of Neurology and the Vivian L. Smith Department of Neurosurgery.

The fourth annual Neuro ICU Symposium, "Ultra-early Brain Resuscitation 2016", will focus on treating patients with neurological injury in the field and optimizing brain resuscitation in emergency rooms. The course has a different look this year and has many exciting highlights: mobile stroke units, ER brain resuscitation, hemodynamic management in the unit, and other controversial hot topics. The event will be held March 23-25, 2016 in Houston, Texas. For more information, visit neuro.memorialhermann.org/cme.

Mischer Neuroscience Institute Research Forum Recap

In April 2015, 70 researchers from institutions at the Texas Medical Center attended a special research forum hosted by Dong Kim, M.D., director of the Mischer Neuroscience Institute and professor and chair of the Vivian L. Smith Department of Neurosurgery at UTHealth Medical School.

The program included an update from the National Institute of Neurological Disorders and Stroke (NINDS) delivered by director Walter Koroshetz, M.D., and the results of the ARUBA Trial, presented by J.P. Mohr, M.D., of Columbia University Medical Center in New York City.

The purpose of the ARUBA Trial (A Randomized Trial of Unruptured Brain Arteriovenous Malformations) is to determine if medical management is better than invasive therapy for improving the long-term outcome of patients with unruptured brain arteriovenous malformations. Begun in 2007 with three centers, the trial has extended to 66 centers, including UTHealth Medical School.

Before joining NINDS in 2007, Dr. Koroshetz served as vice chair of the neurology service and director of stroke and neurointensive care services at Massachusetts General Hospital. He was a professor of neurology at Harvard Medical School and led neurology resident training at Massachusetts General between 1990 and 2007.

Dr. Mohr founded the stroke service and Neuro Intensive Care Unit at Massachusetts General Hospital in the early 1970s. He became the founding chair of the department of Neurology at the University of South Alabama, and in 1983 joined the Neurological Institute of New York at Columbia University Medical Center as the first Sciarra Professor of Neurology.

The Mischer Neuroscience Institute Research Forum was held at the Brown Foundation Institute of Molecular Medicine at The University of Texas Health Science Center at Houston.

The Practice of Nursing





Clinic-Hospital Synergy Improves the Patient Experience

How do you make every patient's encounter with the hospital a VIP experience? Leadership at the Memorial Hermann Mischer Neuroscience Institute is doing it by streamlining communication across the entire patient experience – from presurgical clinic visits to hospitalization to clinic follow-up. They're also investing in hospitality.

"We started by doing something very simple: stepping out of our shoes and into the patient's," says Odun Atunrase, RN, B.S.N., clinical manager of the new Neuroscience Elective Unit at the Mischer Neuroscience Institute. "Those of us on the inpatient side began to realize that if we wanted to think of the entire healthcare experience from the patient's perspective, we needed to understand what was happening during clinic visits before hospitalization. To operate seamlessly as a team, we had to speak one language to our patients from the clinic to the hospital and back to the clinic."

In January 2015, a group of inpatient clinical directors, managers, patient navigators, marketing team members and outpatient clinic directors began meeting with the goal of streamlining the neuroscience experience for patients seen at Mischer Neuroscience Associates (MNA) clinics and admitted to the Mischer Neuroscience Institute. "By the second meeting, we'd created a flowchart of care and identified communication gaps on both the clinic and hospital sides," says Atunrase.

"Our goal was simplicity, clarity and consistency in our communications to patients."

Atunrase's Neuroscience Elective Unit was selected as the pilot project, and he began sending inpatient nurses to MNA clinics in four-hour orientation shifts. "The experience was eye opening," he says. "They came back enlightened, with a deeper understanding of the anxiety patients and families have before hospitalization for elective procedures. Once we understood the patient experience from A to Z throughout the continuum of care, we could focus on how to improve it."

"We started by doing something very simple: stepping out of our shoes and into the patient's."

– Odun Atunrase, RN, B.S.N.

Patient navigators play a key role by examining every detail of the patient experience, from the parking lot to the physician visit at the clinic to hospitalization to discharge through follow-up. They help elective patients through the system, provide presurgical and postsurgical education and ensure that information is shared from the clinic to the hospital.

As complex care specialist for the neuroscience service line, Kim Vu helps bridge the gap between the inpatient and outpatient experience. "My job is about creating flow and setting expectations," Vu says. "I explain what will happen during and after the hospital stay, get answers to any questions they have and follow the patient and family through the entire experience. Patients and their families get so much information while they're here that it's impossible to remember everything. Once they're



discharged, I help connect them with the services they'll need during the rest of their recovery. My position allows me the freedom to create resources for patients to make it a more personal experience."

Odun Atunrase's vision for the Neuroscience Elective Unit includes an investment in hospitality. "We've also worked on how we present ourselves to our patients," he says. "We've condensed patient education materials down to one or two pages about the procedure. Information packets are laminated and given to patients in a binder that includes everything from the menu in a hotel-like format to a list of all medications we prescribe to patients, their descriptions and possible side effects."

Towels are rolled as in a high-end spa, and a bamboo basket in the bathroom contains toiletries. Elegant silk flowers stand in vases at the nurses' stations. In the evenings, unit coordinators offer patients the use of a Kindle Fire programmed with magazines, newspapers and apps for relaxation. Soothing sound machines, sleep masks and earplugs are available to help with relaxation.

The response from patients and families has been good. "They tell us that feeling informed reduces their anxiety," Vu says. "We're getting thank-you notes and comment cards from people who say this is the best hospital experience they've had."

In the 2015 fiscal year rollup of HCAHPS patient satisfaction scores at Memorial Hermann-Texas Medical Center, the neuroscience service line led the hospital at the 76th percentile, more than 25 points higher than the previous year. "Our biggest improvements have been in communication from nurses, responsiveness of hospital staff, pain management and getting patients the support they need," says Nicole Harrison, RN, B.S.N., M.B.A., administrative director of Mischer Neuroscience Institute. "In the end, everything we do is about the patient. Many of our patients have scheduled surgeries, but for most a neuroscience stay is an unscheduled hospital visit, which is very frightening. They trust us with their lives and they deserve the very best care when they come to us."

Nursing at its Best: Increasing Knowledge and Competency to Care for Higher-acuity Patients

At 32 beds, the Neuroscience Intensive Care Unit (NSICU) at the Memorial Hermann Mischer Neuroscience Institute, Houston's market leader, always has a high census. To ensure that patients get the level of care they need quickly as volumes continue to grow, nurses on two other units at the Institute are expanding their knowledge and competency to accommodate ICU-level patients. In the process, they're developing their nursing practice in ways that open doors to career advancement.

“Increasing the capability, knowledge and critical thinking skills of our NIMU staff has enabled us to accept these higher-acuity patients, which allows us to get patients coming in through the ER into the ICU faster. It also gives our nurses options to use these skills to advance their careers.”

– Gesno Ulysse, M.S.N., RN

“With 130 beds, the Institute is the largest neuroscience provider in Houston,” says Nicole Harrison, RN, B.S.N., M.B.A., administrative director. “We want to be able to keep our doors open to patients who come in through the emergency department and require neurosurgery and intensive care. In looking at our data, we recognized that we needed more ICU beds.”

Since mid-2015, the new 16-bed Neuroscience Elective Unit (NEU) has been providing care for elective spine and brain surgery patients, and flexing to accommodate overflow ICU patients when necessary. “It was a huge change for us to grow from the Spine Unit in 2014 to the Neuroscience Elective Unit in 2015, and then make the

leap to caring for ICU patients,” says Odun Atunrase, RN, B.S.N., clinical manager of the NEU. “In 2014 our team led the hospital on the adult side in HCAHPS customer service scores. In adding the skills we needed to care for ICU-level patients, it was also important for us to maintain our high patient satisfaction scores. Dramatic change on a unit is usually associated with a temporary decline in patient satisfaction. We wanted to find ways to advance our capabilities without losing ground on HCAHPS.”

Atunrase collaborated with Colleen Zuckero, RN, B.S.N., CNRN, clinical manager of the Neuroscience ICU, and with Neuroscience ICU education specialists Simy Kandathil, RN, B.S.N., M.S.N., M.H.A., Kavitha Rajan, RN, M.S.N., and Heather Webster, B.S.N., RN, CCRN, CNRN, SCR. “Every nurse on the NEU attended didactic lectures and underwent skills training on ICU equipment to help transition them from floor nurses to the higher-level skills required for ICU patient,” Atunrase says. “Today, we can transition each of our 16 beds from floor level to ICU level, depending on need. The result is an increased capability to get our patients to the level of care they need in the quickest way possible. The new NEU does two things: it supports the Institute's increase in volume of elective brain and spine cases and helps to decompress the ICU.”



Atunrase says the response from nurses on the NEU has been good. “When we began the pilot program, there was some anxiety,” he admits. “But we have ICU resource nurses available at all times and an ICU coach on the unit. Based on feedback from our nurses, we continuously revamp the ICU training to meet their needs and have also added monthly lectures and case studies to keep their knowledge current.”

Despite the change, the NEU finished fiscal year 2015 leading the hospital on the adult side in HCAHPS patient experience scores. “We doubled our staff, went through intensive ICU training and still maintained our No. 1 position,” he says. “We’re proud of that success and of our culture of putting patients first.”

Nurses in the Neuroscience Intermediate Care Unit (NIMU) have also increased their skills and are also providing care for ICU-level patients. Gesno Ulysse, M.S.N., RN, NIMU clinical nurse manager, set a goal of training 100 percent of his team to manage the care of stable ventilator patients, stable external ventricular drain patients and those who are on intravenous drips that don’t require frequent titration.

“Increasing the capability, knowledge and critical thinking skills of our NIMU staff has enabled us to accept these higher-acuity patients, which allows us to get patients coming in through the ER into the ICU faster,” Ulysse says. “It also gives our nurses options to use these skills to advance their careers.”

Training of the NIMU staff took place over several months and required close collaboration between respiratory therapy, nursing and critical care physicians. Education was facilitated by Susan Nevada, M.S.N., RN, CNRN, SCRN, neuroscience clinical education specialist. “The educational effort was done in three phases,” Nevada says. “Phase 1 was a didactic lecture explaining oxygenation, respiratory function and oxygenation dynamics. Phase 2 involved rounding in the ICU to review basic tracheostomy care with nurses and clarification of the roles of nurses and respiratory therapists in caring for patients on ventilators. Phase 3 was a work sheet on a random mix of six patients on ventilators related to settings, lung sounds, disease process, diagnostic lab results and repositioning of patients. We also partnered with inpatient pharmacists to identify a list of IV drips used with stable patients. Patients transferred to the NIMU have been carefully selected based on what the ICU attendant and respiratory therapy defines as a stable patient amenable to transfer. It has gone very smoothly.”



Nursing Initiatives Put More Care into Health Care

Empowering nurses at the bedside to implement quality initiatives has led to dramatic improvements in quality metrics across the Memorial Hermann Mischer Neuroscience Institute at the Texas Medical Center.

“The improvements in quality were not made by one or two people, but by collaborative work involving the entire staff,” says Enedra Allen-McBride, RN, M.S.N., clinical director of patient care. “Through education, we give our nurses the tools they need to implement positive change, and they run with it. That sense of engagement and empowerment has made a huge difference in the patient experience.” The initiatives below are just a few of many led by nurses at the Mischer Neuroscience Institute.

Best Practices for Falls Reduction

From 700,000 to 1 million patients suffer a fall in American hospitals each year, and while falls are rarely fatal, at least 30 percent of inpatient falls result in moderate to severe injury. In July 2013, nurses on the Neuroscience Acute Care Unit implemented an action plan that reduced falls by 51 percent over 24 months.

“That’s tremendous work,” says Janelle Headley, B.S.N., RN, clinical nurse manager of the unit. “In fiscal year 2014, we reduced falls by 31 percent. In fiscal year 2015, which ended on June 30, we reported an additional 20 percent reduction. The key to our success is staff engagement and a focus on improving customer service.”

The success of the initiative led to an invitation to present the action plan and its results at the 2015



American Nurses Credentialing Center National Magnet Conference® held in October in Atlanta. An analysis of falls on the Neuroscience Acute Care Unit showed that males between the ages of 40 and 65 were at the highest risk of falling, and most were falling in attempts to use the restroom. The nurses began by targeting that at-risk population with purposeful hourly rounding.

“During rounding, we offer to help patients to the restroom instead of waiting until they call,” Headley says. “We also assess the location of the five T’s – TV, tray/ table, telephone, tissues and trash – to make sure they’re accessible to the patient, check the entire environment and ask if the patient has any specific needs. We take that opportunity to evaluate whether the patient is appropriate for any of the other elements of the falls-reduction initiative, including a low-boy bed,

fall mat, a room close to the nurses station or a telesitter.”

Telesitters allow trained staff to view and talk with patients 24/7 from a central monitoring station linked to a bedside camera. When observers notice a problem or see a patient trying to get out of bed, the technology allows them to communicate with the patient and, if necessary, to call a nurse to the room.

With their initial success on the Neuroscience Acute Care Unit, nurses extended their focus to another population at high risk of falling – stroke patients. “As stroke patients progressively regain their strength, they overestimate their ability to move. When they try to get up, they fall,” Headley says. “As part of the initiative, we placed all

“As stroke patients progressively regain their strength, they overestimate their ability to move. When they try to get up, they fall.”
 – Janelle Headley, B. S. N., RN

stroke patients in low-boy beds with protective floor mats and a telesitter.”

Nurses review progress made in the falls-reduction initiative in a Monday morning huddle. Any falls that occur are posted on the nursing dashboard to encourage staff accountability.

“The falls data is part of our nursing scorecard,” Headley says. “The huddle keeps everyone informed and improves staff engagement and accountability for keeping our patients safe. The key to success is purposeful hourly rounding and anticipating patient needs before they call us. Good customer service and a relentless focus on safety add up to a better patient experience.”



Stroke Coordinator Superheroes

In 2013, the Memorial Hermann Mischer Neuroscience Institute received the highly coveted Comprehensive Stroke Center (CSC) certification from The Joint Commission and the American Heart Association/American Stroke Association. Less than a year later, the AHA recognized Memorial Hermann-Texas Medical Center with the Get With The Guidelines®—Stroke Gold Plus Achievement Award. The AHA recertified the hospital in 2015.

The Institute remains the only facility in the Greater Houston area with CSC certification and four stroke program coordinators who ensure that all stroke patients admitted to the hospital receive evidence-based care. They also share their knowledge with nurses on other units, with patients and families through inpatient education programs and with the community through outreach to the general public and to EMS providers.

“Our job is to identify and track – on a daily basis – every stroke patient who comes through our doors as well as patients who have a stroke during hospitalization,” says stroke program coordinator Christine Glendening, RN, SCRN. “We serve as a direct resource for stroke-related questions from nurses, particularly when they have unusual cases, and work with nurses and physicians to ensure that we’re meeting all of our core measures.”

As the go-to people for stroke education, Glendening and her counterparts Isabel DeGuzman, M.S.N., RNBC, CNL; Stephanie Cooper, B.S.N., RN; and Sandi Shaw, B.S.N., RN, provide formal and one-on-one training,



report on metrics and core measures, and conduct annual refresher courses for nurses. “Education is a big part of the service we provide,” DeGuzman says. “In addition to coordinating weekly sessions for inpatients and their families, we help other hospitals begin the process of Primary Stroke Center certification.”

In March 2015, neuroscience clinical education specialist Susan Nevada, M.S.N., RN, CNRN, SCRN, was one of five nurses from California, Florida, Kentucky, Texas and Utah who collaborated to present the results of recent stroke initiatives at the American Association of Neuroscience Nurses 47th Annual Educational Meeting held in Nashville, Tennessee.



Titled “Stroke Coordinator Superheroes,” the presentation provided direction to stroke coordinators who are new to their roles and offered advice on how Primary Stroke Centers can achieve advanced certification by The Joint Commission.

For her part of the presentation, Nevada analyzed five years of stroke data from the Get With The Guidelines stroke registry and compared data from Comprehensive Stroke Centers with numbers from Primary Stroke Centers and numbers from all hospitals. She also presented a literature review that identified gaps and variables in stroke care,

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– Isabel DeGuzman, M.S.N., RN-BC, CNL

noting that African-Americans and middle-age adults are populations that arrive beyond tPA treatment windows.

“Variables that impact these populations in seeking treatment are their arrival modes to the hospital and their health beliefs,” Nevada says. “Another factor that may delay treatment is lack of knowledge of EMS dispatch and EMS providers, especially

in rural areas. The literature suggests that educating EMS dispatchers to cue in on key stroke indicators will elevate EMS provider responsiveness, which is one of the important roles our stroke coordinators play.”

Neuroscience Nursing Academy Enhances Knowledge and Skills

Beginning in January 2016, nurses at the Memorial Hermann Mischer Neuroscience Institute will have the opportunity to expand their knowledge of their specialty at the newly created Neuroscience Nursing Academy. Designed to give new nurses a comprehensive introduction to neuroscience, the academy is also open to experienced nurses who want to increase their knowledge of evidence-based practice.

“Neuroscience nursing is a relatively small specialty,” says Heather Webster, B.S.N., RN, CCRN, CNRN, SCRN, clinical education specialist, who is spearheading the development of the Neuroscience Nursing Academy curriculum. “Proficiency requires time and a commitment to developing the unique skill set that allows nurses to provide highly specialized care to our patients and families. In nursing school, students have minimal exposure to neuroscience. We’re creating a program that will give them a knowledge base that allows them to excel.”

The academy was created in response to the increasing number of new graduate nurses and nurses with limited knowledge and experience with the neuroscience patient population. A multidisciplinary team of nurses, physicians, residents, neurorehabilitation specialists and pharmacists will provide instruction in four-hour sessions held once a week over a six- to eight-week period. Each year, four groups of 25 nurses will go through the program, which is mandatory for nurses with less than a year of experience.

“I’m excited about the program,” Webster says. “In addition to supporting nurses new to neuroscience, I believe it will revolutionize the way we provide nursing care and encourage nurses to engage in their specialty

more deeply. We’ll do a pre- and post-academy survey of participants’ knowledge base and their perception of involvement with our multidisciplinary team. Our annual employee survey scores are already high in the areas of engagement and staff development. We think giving nurses these new educational tools will further enhance their knowledge and engagement, which ultimately leads to improved outcomes, retention of staff and all-around satisfaction.”

Hardwiring Evidence-based Practice at the Comprehensive Stroke Center

For more than a decade, nursing as a profession has promoted and advocated for evidence-based practice (EBP). Since the early 2000s, nurses have had at least some component of EBP integrated into their formal education.

“Evidence-based practice has rapidly become the standard by which clinical practice is formed and measured,” says Hope Moser, D.N.P., ANP BC, WHNP BC, SCRN, advanced practice nurse and program coordinator at the Memorial Hermann Comprehensive Stroke Center (CSC) at the Mischer Neuroscience Institute. “EBP closes the gap between research and clinical practice. It challenges nurses to ask the question ‘why’ when they implement old and new practices.”

Achieving and sustaining EBP requires an organizational commitment to strategic goals and a systematic process to reach desired outcomes. Memorial Hermann-Texas Medical Center has adopted the ACE Star Model of Knowledge Transformation, which is structured using components common to most EBP models: identification of a clinical problem, search for the best evidence, critical appraisal of the literature, implementation of practice change and evaluation of outcomes. Focus is

placed on the bench-to-bedside approach – translating research into practice.

“Firm commitment on the part of our executive leadership enabled the Comprehensive Stroke Center team to meet The Joint Commission’s strict requirements for certification,” says Dr. Moser, who has presented widely on evidence-based practice. “The CSC was created under Clinical Practice Guidelines based on the most recent and best clinical evidence, and the Stroke Program team follows rigorous requirements for rapid identification of stroke, diagnostic testing capability, neurosurgical services and clinical performance measures. We’ve been fortunate to maintain a robust organizational infrastructure that continues to grow.”

Sustaining the CSC requires a dedicated and proactive team that collaborates among disciplines. Quality improvement initiatives are predominately driven by data derived from patient care, as well as metrics from clinical practice, including patient satisfaction, length of stay and elimination of hospital-acquired infections. The CSC team is headed by Sean Savitz, M.D., director of the Vascular Neurology Program at UTHealth Medical School; Nicole Harrison, RN, M.B.A., administrative director of the Mischer Neuroscience Institute; and Dr. Moser, who encourages nurses to embrace the concept of evidence-based practice.



“As nurses working in an academic medical institution where the staff has earned American Nurses Credentialing Center Magnet Recognition Program® distinction and multiple advanced disease-specific certifications through The Joint Commission, we live evidence-based practice on a daily basis.”

– Hope Moser, D.N.P., ANP BC, WHNP BC, SCRNP



“As nurses working in an academic medical institution where the staff has earned American Nurses Credentialing Center Magnet Recognition Program® distinction and multiple advanced disease-specific certifications through The Joint Commission, we live evidence-based practice on a daily basis,” she says. “While new nurses are familiar with the concept of EBP, more tenured nurses, myself included, may have engaged in evidence-based practice masquerading as research. Evidence-based practice requires research, and

nurses who are interested in research have the opportunity to conduct it here.

“I encourage nurses who would like to play a more integral part in the process of change to reach out to their managers and unit quality leaders,” Dr. Moser says. “EBP drives quality improvement initiatives that ensure that we provide the best care to our patients and families and ultimately improve health care.”

Driving Improvements in Care

A New Clinical Coordinator Role Prepares Nurses for Leadership

It's not uncommon for nurse managers to be promoted from within after demonstrating exceptional bedside nursing and charge nurse skills. What is unusual is a systematic program to groom and mentor them before they take on full-time leadership roles. That's exactly what the Memorial Hermann Mischer Neuroscience Institute's new clinical coordinator role is designed to do.

"The clinical coordinator role is ideal for nurses who are interested in an introductory leadership role," says Enedra Allen-McBride, M.S.N., RN, clinical director of patient care at the Institute. "It provides a glimpse into management

and an opportunity to hone your skills without having to dive in head first. It also offers more responsibility and opportunities to get involved in leadership on a broader scale, and gives a great introduction to the fundamentals of management. Leadership scholars routinely ask whether leaders are born or made. Some people are innately wired to excel in leadership roles, but with a strong leadership development structure and the will to work hard, learn and gain experience, I believe that anyone with an interest can learn the art of leadership."

The clinical coordinator role came about after an assessment of the Institute's nursing leadership structure and span of control for two of its largest units: the



Neuroscience Intensive Care Unit (NSICU) with 32 beds and 112 full-time equivalents and the Neuroscience Acute Care Unit (NACU), a 51-bed unit with 91 full-time equivalents. Both units are complex in the nature of care provided, and in both, a clinical nurse manager was responsible for all aspects of the unit including managing and supervising, coaching and mentoring, operations management and ensuring patient safety and quality. After re-evaluating the structure, leadership at the Institute developed the clinical coordinator role, a new configuration that relieves managers of some of their responsibility and provides leadership coverage 24/7.

“When our nurses completed the annual engagement survey in 2014, they gave us a lot of good feedback about the support they needed from their managers,” says Colleen Zuckero, RN, B.S.N., CNRN, clinical manager of the NSICU. “In response we added four clinical coordinator positions – two for days and two for nights in both the NSICU and the Neuroscience Acute Care Unit. We wanted to have some clinical components to the position as well as administrative responsibilities, so we decided to put them in the charge nurse role for two days and the clinical coordinator role for the other two days. In the charge nurse role they have a keen eye to where we need support and process improvements. As part of the leadership team on the administrative side, they serve as assistant nurse managers. By being both clinical and administrative, they have the opportunity to see both sides.”

“Our managers and directors have taken really good care of us, putting us through classes in the Leadership Development Academy to get us ready for this role. When you feel supported, you know you can make a difference.”

– Rosanna de las Alas, RN, B.S.N, M.Ed.

Rosanna de las Alas, RN, B.S.N, M.Ed., clinical coordinator for the NSICU, has seen a sea change in the unit during her 17 years of service at the Institute, including growth to 32 beds and a dramatic increase in volumes. “The clinical coordinator role gives me the best of two worlds,” she says. “By shadowing Colleen and serving as her assistant, I learn what a manager does. On the charge nurse side, we oversee the function of the unit and bed management. It’s great

as a stepping-stone to get your feet wet in management. Our managers and directors have taken really good care of us, putting us through classes in the Leadership Development Academy to get us ready for this role. When you feel supported, you know you can make a difference.”

Janelle Headley, B.S.N., RN, clinical nurse manager of the Neuroscience Acute Care Unit (NACU), also has four clinical coordinators who serve as an extra resource and support for both her and her staff. “In addition to having the opportunity to attend leadership classes, they assist with overall clinical operations, staff management and coordination of patient care and customer service,” Headley says. “On the administrative side, they lead quite a few initiatives on the unit.”

Anna Patricia Traje, B.S.N., RN, clinical coordinator on the NACU, describes her role as bridging the gap between management and clinical staff. “On a unit as large as ours, it’s very hard for Janelle to communicate with each employee on a personal basis,” she says.

“The four of us act as leaders and go-betweens to provide the additional support the staff needs to be successful. We serve as the point people to make sure communication about patients is transmitted between the night and day shifts and that the unit operates smoothly. It’s great to be part of a team that really cares about the development of nurses and supports us in such a way that we’re always growing and transforming.”

Colleen Zuckero acknowledges the new role’s part in the Mischer Neuroscience Institute’s succession plan. “As clinical coordinators, they have the opportunity to walk alongside managers so that when we’re ready to pass the baton, they will also be ready,” she says. “Preparing future managers and future directors is real proactive nursing. With the support we have from Nicole Harrison and

Enedra Allen-McBride, this unit is thriving. Our HCAHPS scores in 2014 were in the 66th percentile. We finished 2015 at 83 percent. Amazing! Knowing that we have this kind of support generates a lot of excitement and makes us feel valued.”

Neuro PACT Empowers Nurses to Collaborate Across Units

The Neuroscience ICU (NSICU) and the Neuroscience Acute Care Unit are the largest of the Memorial Hermann Mischer Neuroscience Institute’s six nursing units. Recognizing that these two units have similar challenges, quality coordinators Allison Murphy, RN, B.S.N., CNRN, and Gabrielle Edquilang, RN, thought, “Why don’t we get these nurses together and start working collectively on issues that cross unit lines?”



The result is the Neuroscience Professional Action Council Team (Neuro PACT), which brings together representatives from each of the six units to identify problems and solve them as a service line. Led by Murphy and Edquilang, Neuro PACT meets once a month and is open to all staff members with an interest in process improvement. Response has been good, with between 25 to 30 staff members in attendance.

“Neuro PACT is strengthening the neuroscience service line by providing a safe environment to bring up issues that affect every unit,” Murphy says. “Staff members come and voice their concerns, and if someone sitting on the council has ideas about how solve a problem, we ask them to run with it. If there’s already a committee working on a particular issue, we’ll turn it over to the committee. If it’s a new issue, we’ll find the right people to take care of it. Some of the issues that come up are quick fixes, and others are not. By working together we are collectively creating change that will spread to all of our units.”



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– Allison Murphy, RN, B.S.N., CNRN



The team has undertaken two initiatives since its inception: smooth discharge of patients and bed flow. “These are issues that involve every unit in the service line,” Murphy says. “In addition to looking at the barriers to moving patients smoothly from the ICU or the Stroke Unit to the NACU and then to discharge, we’re exploring what we can do collaboratively to reduce patient and family anxiety as they transfer from one unit to another. Neurological injuries can be life changing, and many families are unsure of what their loved ones want, so their

anxiety level is very high. They become accustomed to a unit and their nurses, and then they learn that they’re going to be moved to another unit. We want to do whatever we can to decrease patient and family anxiety and assure them that they’re moving in the right direction.”

Most staff members who attend Neuro PACT meetings are bedside nurses. “It’s a place where they feel empowered to share their concerns,” Murphy says. “They come back the following month to see what progress we’ve made on the issues they’ve raised. In doing so, they’re involving themselves in our future as an Institute. By collaborating with each other across units, we’ll all improve.”



Scope of Services and *Quality* Outcomes





Brain Tumor

Neuro-oncologists Jay-Jiguang Zhu, M.D., Ph.D., and Sigmund H. Hsu, M.D., continue to expand the capabilities of the Brain Tumor Center at the Memorial Hermann Mischer Neuroscience Institute at the Texas Medical Center and in Mischer Neuroscience Associates practices across the city. Dr. Zhu, fellowship trained at Massachusetts General Hospital, focuses his practice on primary brain tumors – gliomas, meningiomas and pituitary adenomas – and primary CNS lymphomas, as well as brain metastases and leptomeningeal spread of systemic malignancies. He is also interested in quality of life, including cognitive function during and after radiotherapy and chemotherapy; neurological complications of systemic chemotherapies; and clinical trials focused on developing new treatment options for primary brain tumors and CNS metastases. Dr. Hsu, fellowship trained at The University of Texas MD Anderson Cancer Center, has clinical and research interests in the discovery of new and more effective therapies for patients with primary brain tumors, treatment of metastatic cancer to the brain and spinal cord, and the evaluation and treatment of neurological problems in cancer patients.

Dr. Zhu is principal investigator in several trials that give eligible study participants access to new and advanced treatments. A Phase III multicenter, randomized, controlled trial is designed to test the efficacy and safety of a medical device called Novo TTF-100A for newly diagnosed glioblastoma multiforme (GBM) patients in combination with temozolomide, compared to temozolomide alone. The device, which patients wear on their scalp, provides a constant, safe, low-voltage electric field that has been shown to reduce tumor cell survival and division capacity.

Dr. Zhu is also principal investigator of a randomized, double-blind, controlled Phase IIB clinical trial testing the safety and efficacy of the vaccine ICT-107 for newly diagnosed GBM patients following resection and chemoradiation, which began enrollment in August 2011. In addition, he is leading an open-label Phase I/II (Safety Lead-In) study of trans sodium crocetininate (TSC) with concomitant treatment of fractionated radiation therapy and temozolomide in newly diagnosed GBM, examines the safety and efficacy of radiation sensitizer of TSC in combination with fractionated radiation.

Dr. Zhu is also principal investigator in three new trials currently enrolling patients: a Phase II trial studying the safety and tolerance of intravenous 4-Demethy-4-cholesteryloxy carbonylpenclome (DM-CHOC-PEN) in patients with malignancies involving the central nervous system; a Phase II/III randomized trial of veliparib or placebo in combination with adjuvant temozolomide in newly diagnosed glioblastomas with MGMT promoter hypermethylation; and a Phase III trial evaluating DCVax[®]-L, autologous dendritic cells pulsed with tumor lysate antigen for the treatment of GBM.

Dr. Hsu is principal investigator in the trial of a novel taxol chemotherapy compound, TPI-287, which crosses the blood-brain barrier and will be administered in combination with bevacizumab, versus bevacizumab alone in adults with recurrent glioblastoma. He is also leading a Phase 2 dose-escalation study of TPI-287 in combination with bevacizumab in adults with recurrent or progressive glioblastoma following a bevacizumab-containing regimen.



The Brain Tumor Center was chosen as a site for the FoundationOne™ Registry study, a prospective observational study to examine practice patterns and impact on clinical decision-making associated with the FoundationOne next-generation sequencing test. Led by Dr. Hsu, the study enables physicians affiliated with the Institute to recommend optimal personalized treatment for patients with cancer. Patients benefit from other innovative and advanced technologies, including

motor and language mapping, functional neuroimaging, frameless stereotactic navigation in surgery and awake craniotomies performed under local anesthesia, as well as minimally invasive procedures, including neuroendoscopy and stereotactic radiosurgery.

In addition to routine multidisciplinary brain tumor clinics, physicians affiliated with the Mischer Neuroscience Institute offer patients specialized care through multiple

RESEARCH HIGHLIGHT

A Phase II/III Randomized Trial of Veliparib or Placebo in Combination with Adjuvant Temozolomide in Newly Diagnosed Glioblastoma with MGMT Promoter Hypermethylation

PRINCIPAL INVESTIGATOR: **Jay-Jiguang Zhu, M.D., Ph.D.**

Associate Professor, Vivian L. Smith Department of Neurosurgery, UTHealth Medical School

This randomized Phase II/III trial studies the efficacy of temozolomide and veliparib together, and compares them to temozolomide alone in treating patients with newly diagnosed glioblastoma multiforme (GBM). Veliparib may stop the growth of tumor cells by blocking some of the DNA repair enzymes needed for cell growth.

The primary objective is to test whether the experimental combination of ABT-888 (veliparib) and TMZ (temozolomide), compared to the control of placebo combined with TMZ, significantly extends overall survival in newly diagnosed GBM patients with tumor O-6-methylguanine-deoxyribonucleic acid (DNA) methyltransferase (MGMT) promoter hypermethylation.

Secondary objectives are to test whether the experimental treatment improves objective tumor response, and whether the experimental treatment is associated with significantly greater rates of grade 3 or higher adverse events.

Patients who participate in the experimental arm of the study will receive temozolomide PO QD on days 1-5 and veliparib PO BID on days 1-7. Treatment repeats every 28 days for six courses in the absence of disease progression or unacceptable toxicity. Patients in the placebo comparator arm receive temozolomide and placebo PO BID on days 1-7. Treatment repeats every 28 days for six courses in the absence of disease progression or unacceptable toxicity. Estimated enrollment for the multicenter study is 440 patients, with an expected primary completion date of June 2022.

programs and clinics. The Pituitary Tumor and Vision Change Clinic ensures early and precise diagnosis of patients with pituitary and other parasellar tumors, which may cause a broad range of disorders and present with a variety of symptoms, including hormonal changes, vision loss and infertility. The Skull Base Program at the Institute treats patients with these tumors through minimally invasive endoscopic surgery, when appropriate.

At the Brain Metastases Clinic, a team of affiliated neuro-oncologists, neuroradiologists, radiation oncologists, neuropathologists, oncologists and neurosurgeons works closely with oncologists to provide personalized and innovative care to patients with brain tumors.

Specialists at the Cancer Neurology Clinic treat patients with neurological issues resulting from chemotherapy.

At the Neurogenetics Clinic, a genetic counselor identifies genetic risk and explains inheritance patterns, provides education on the natural history of disease and discusses the risks, benefits and limitations of available genetic testing options.

The Mischer Neuroscience Institute acquired the region's first Leksell Gamma Knife® in 1993, and is now using the more advanced Leksell Gamma Knife® Perfexion™. Patients who benefit from the Perfexion's sophisticated software with dose-to-target conformation include those

QUALITY & OUTCOMES MEASURES

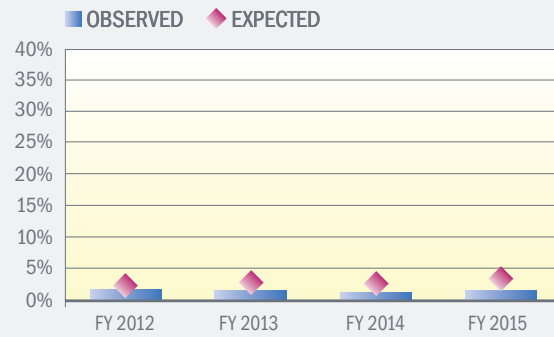
with meningiomas and vestibular schwannomas; arteriovenous malformations; medically refractory trigeminal neuralgia; and metastases. Multiple intracranial metastases can usually be treated in a single outpatient procedure. Neurosurgeons affiliated with the Institute have performed more than 3,500 Gamma Knife procedures.

The Varian Trilogy linear accelerator is the first in a powerful new generation of cancer-fighting technologies, offering highest dose rates for shorter sessions. The system delivers 3-D conformal radiotherapy, IMRT, extracranial and intracranial stereotactic radiosurgery, fractionated stereotactic radiation therapy, stereotactic body radiosurgery (SBRT) and intensity-modulated radiosurgery for cancer and neurosurgical treatment.

The clinical team affiliated with the Brain Tumor Center works closely with referring physicians throughout the radiosurgical treatment process. A neurosurgeon and a radiation oncologist assess each candidate to determine whether radiosurgical treatment is the best option. Nurse navigators work directly with patients on scheduling and pretreatment education, and provide support and care on the day of treatment. The Center also sponsors a well-attended brain tumor support group that meets the second Wednesday of every month.

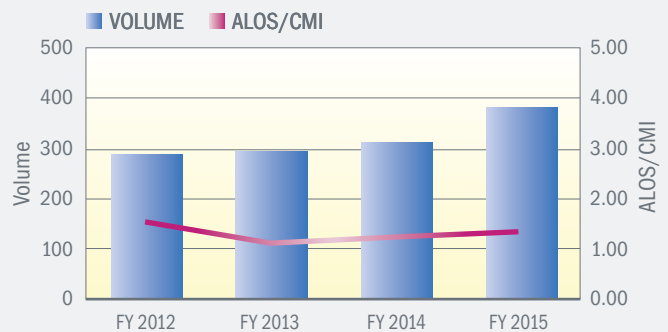
Breakthrough approaches to treatment provided by specialists affiliated with the Mischer Neuroscience Institute have led to an increase in the number of patients treated for brain tumors. Since 2009, volumes have increased by nearly 50 percent.

Brain Tumor: Inpatient Mortality

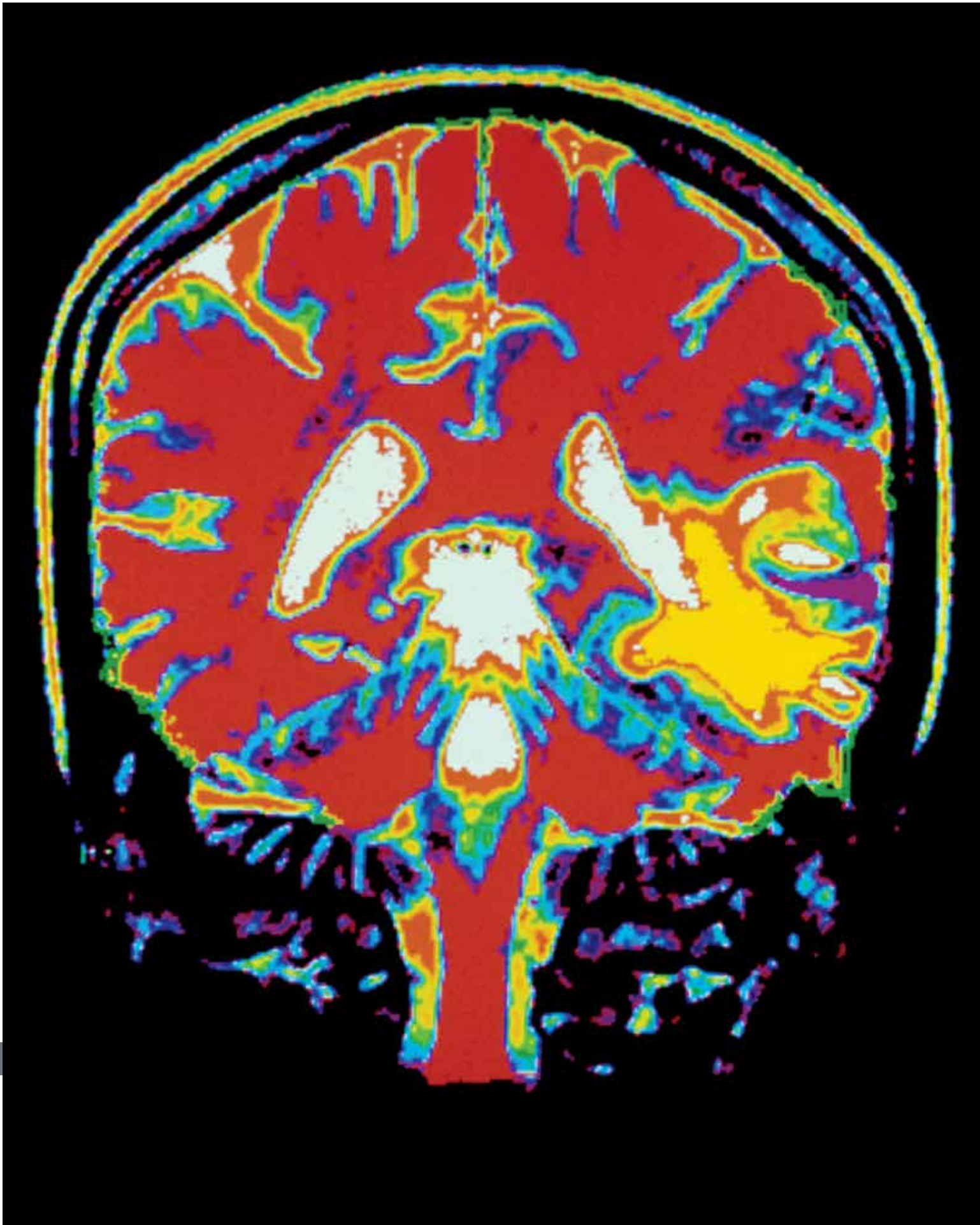


Source: Chart data from the University HealthSystem Consortium

Brain Tumor: Volume & Length of Stay (CMI Adjusted)



Source: Chart data from the University HealthSystem Consortium



Cerebrovascular

In 2013, the Memorial Hermann Mischer Neuroscience Institute at the Texas Medical Center received the highly coveted Comprehensive Stroke Center (CSC) certification from The Joint Commission and the American Heart Association/American Stroke Association. Under the direction of Sean Savitz, M.D., the Memorial Hermann Comprehensive Stroke Center at the Mischer Neuroscience Institute was the first stroke program in the state of Texas to meet The Joint Commission's rigorous standards, solidifying its position among an elite group of providers in the country focused on complex stroke care. The Institute remains the only facility in the Greater Houston area with the CSC certification. Less than a year later, the AHA recognized Memorial Hermann-Texas Medical Center with the Get With The Guidelines® – Stroke Gold Plus Achievement Award. The AHA recertified the hospital in 2015.

The Stroke Center's cerebrovascular continuum of care spans the gamut, from pre-hospital ambulance care to the emergency-center setting, and extends through a 12-bed dedicated inpatient stroke unit to neurorehabilitation provided in a 23-bed inpatient unit and at TIRR Memorial Hermann, an international leader in rehabilitation and research. Patients benefit from comprehensive inpatient and outpatient services, state-of-the-art technology, and innovative therapies and techniques.

Opened in 1988 as one of the first dedicated stroke programs in the world, the Stroke Center is home to the 10-county Greater Houston area's largest onsite stroke team. Neurologists affiliated with the Center use

leading-edge technology to diagnose and treat more than 2,000 stroke and aneurysm patients annually, ensuring that each patient gets the appropriate treatment as quickly as possible. By working closely with the Houston Fire Department and local EMS services, the stroke team has logged an impressive record of success in the administration of tPA – more than 10 times the national average of 2 to 3 percent.

In addition to breakthrough treatment for stroke, the cerebrovascular team provides coordinated care for patients with aneurysms, carotid occlusive disease and intracranial vascular malformations, including open surgical and endovascular treatments such as angioplasty, stenting and embolization. Also available is the Pipeline™ endovascular flow-diverting stent, a device that reconstructs the parent vessel lumen of difficult-to-reach aneurysms as an alternative to clipping or endovascular coiling. Affiliated neurosurgeons are skilled at microvascular clipping of aneurysms, using the best skull base approaches to minimize brain manipulation, extracranial-intracranial bypass procedures, carotid endarterectomy and hemicraniectomy for severe strokes. State-of-the-art radiosurgery using the Leksell Gamma Knife® Perfexion™ is regularly used for vascular malformations best treated non-surgically.

The Stroke Center currently is staffed by three full-time academic neurosurgeons dedicated to cerebrovascular practice: Arthur L. Day, M.D.; P. Roc Chen, M.D.; and Mark Dannenbaum, M.D. Drs. Chen and Dannenbaum are dually trained in both open and endovascular

RESEARCH HIGHLIGHT

Optimizing Patient Selection for Endovascular Treatment in Acute Ischemic Stroke (SELECT)

PRINCIPAL INVESTIGATOR: **Amrou Sarraj, M.D.**
Associate Professor, Department of Neurology,
UTHealth Medical School

Five recently published randomized controlled trials have shown the superiority of intra-arterial therapy (IAT) in acute ischemic stroke patients with large vessel occlusion in the anterior circulation, compared to medical therapy, including intravenous tPA. The next steps are to enhance and optimize patient selection.

SELECT is a multicenter observational prospective study implementing a protocol to acquire imaging and clinical variables known to affect clinical outcomes after endovascular therapy. The study will compare the different selection methods and criteria currently used in practice for acute ischemic stroke patients with large vessel occlusion in the anterior circulation. It will evaluate prospectively different selection methodologies for endovascular therapy, and compare them against each other to identify the method that provides the highest predictive value in the selection of patients for IAT and devise a formula that predicts patients' outcomes.

UTHealth Medical School is the hub center in this study, which will enroll a total of 500 patients – 250 treated with endovascular therapy and 250 in the medical arm – at eight centers across the United States. Researchers expect the study to be completed in December 2017.

neurosurgery. With the addition of a fourth practitioner, Spiros Blackburn, M.D., Mischer Neuroscience Associates has extended its cerebrovascular program to Memorial Hermann Memorial City Medical Center and Memorial Hermann The Woodlands Hospital. Dr. Blackburn specializes in cerebrovascular and skull base surgery and endovascular neurosurgery.

The Mischer Neuroscience Institute/UTHealth Telemedicine Program, directed by Teddy Wu, M.D., extends stroke and neurology expertise far beyond the Institute's walls, helping emergency physicians in community hospitals throughout Southeast Texas make accurate diagnoses and save lives. Remote presence robotic technology has enhanced the telemedicine program by linking outlying hospitals electronically to the Neurology department, providing real-time visual interaction between neurologists and patients, and allowing affiliated neurologists to review CT scans and advise local physicians on treatment protocols. Through telemedicine, physicians can now offer patients in outlying communities an opportunity to participate in clinical trials that otherwise would be unavailable to them, which expands medical knowledge as it saves lives. Baptist Beaumont Hospital and Memorial Hermann Southwest Hospital were early adopters of telemedicine. Since then, 13 more sites in Southeast Texas have gone live with the technology: Memorial Hermann Memorial City Medical Center, Memorial Hermann Northwest Hospital, Memorial Hermann The Woodlands Hospital, Huntsville Memorial Hospital, Matagorda Regional Medical Center, Baptist Orange Hospital, the Medical Center of Southeast Texas in Port Arthur, Citizens Medical Center in Victoria, St. Joseph Hospital-Downtown in Houston, DeTar Healthcare System in Victoria, Tomball Regional Medical Center in Tomball, UTHealth Northeast in Tyler, and Brazosport Regional Health System in Lake Jackson.



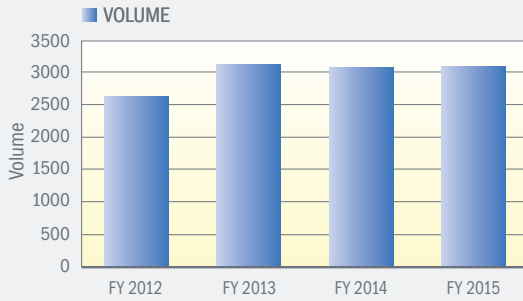
Physicians at the Mischer Neuroscience Institute and UTHealth Medical School conduct more research than any other stroke program in the south or southwestern United States, participating in multicenter and single-center clinical trials testing new treatments for patients who cannot be treated elsewhere. The stroke center was chosen as the only regional coordinating center in Texas and the Southwest United States to serve in StrokeNet, a national network funded by the National Institute of Neurological Disorders and Stroke to conduct clinical stroke trials across the country. The Stroke Center is serving as the flagship to coordinate clinical stroke trials throughout the region.

Pioneering stroke research at UTHealth and the Mischer Neuroscience Institute has included thrombolytic treatment

for wake-up stroke, the safety of pioglitazone for hematoma resolution in intracerebral hemorrhage, argatroban in combination with recombinant tissue plasminogen activator for acute stroke, multi-agent vasodilator infusion therapy versus current typical single-agent therapy for cerebral vasospasm, and autologous bone marrow stem cell treatment for acute ischemic stroke. Investigators also seek to increase the effect of standard-of-care treatment by combining tPA with ultrasound, anticoagulants and hypothermia, as well as exploring new methods of stroke prevention. Finally, with the advent of recent clinical trials showing the benefit of intra-arterial endovascular therapy for acute ischemic stroke, Amrou Sarraj, M.D., has been awarded a grant from Stryker Neurovascular to conduct a multicenter trial to determine which patients will benefit most from this treatment.

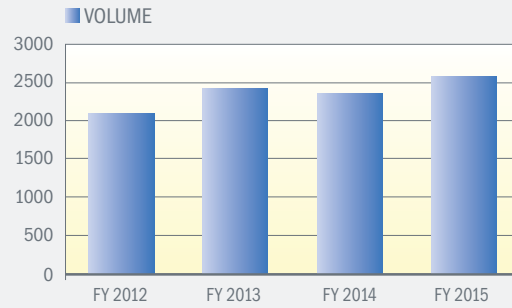
QUALITY & OUTCOMES MEASURES

Cerebrovascular Volume



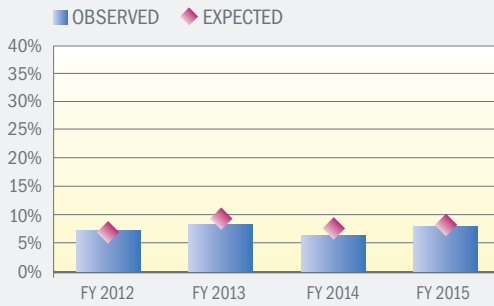
Source: Chart data from the University HealthSystem Consortium

Stroke Volume



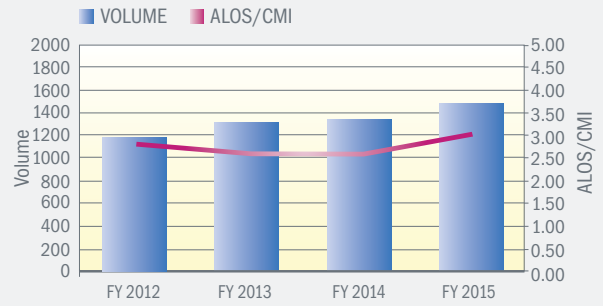
Source: Chart data from the University HealthSystem Consortium

Acute Ischemic Stroke: Inpatient Mortality



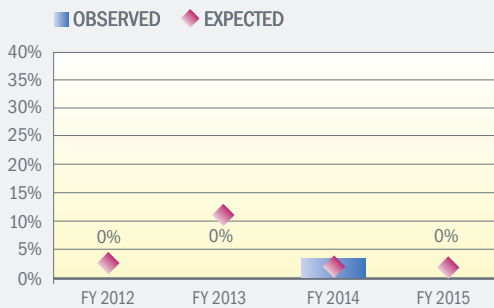
Source: Chart data from the University HealthSystem Consortium

Acute Ischemic Stroke: Volume & Length of Stay (CMI Adjusted)



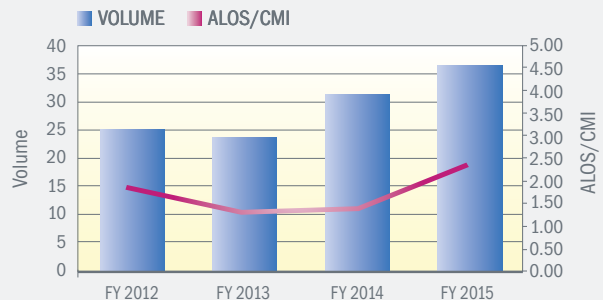
Source: Chart data from the University HealthSystem Consortium

Arteriovenous Malformation: Inpatient Mortality



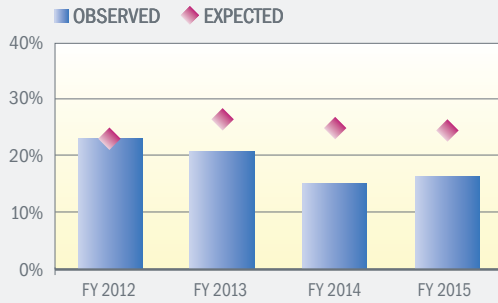
Source: Chart data from the University HealthSystem Consortium

Arteriovenous Malformation: Inpatient Volume & Length of Stay (CMI Adjusted)



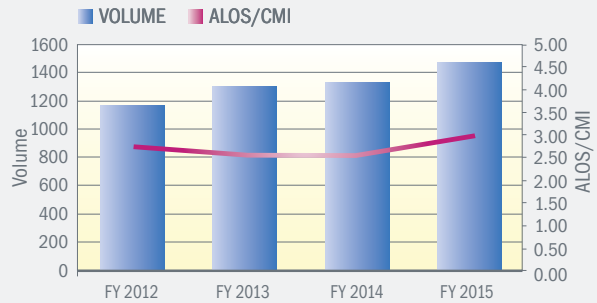
Source: Chart data from the University HealthSystem Consortium

Intracerebral Hemorrhage: Inpatient Mortality



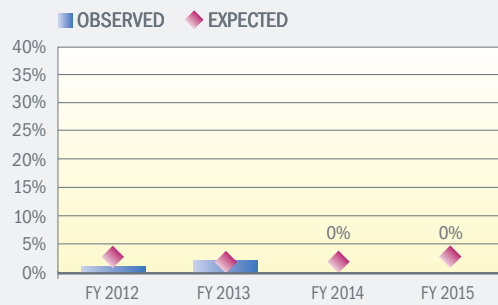
Source: Chart data from the University HealthSystem Consortium

Intracerebral Hemorrhage: Volume & Length of Stay (CMI Adjusted)



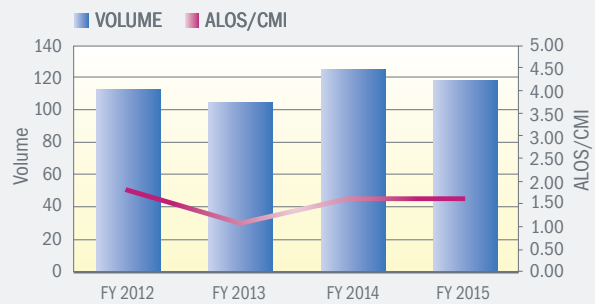
Source: Chart data from the University HealthSystem Consortium

Unruptured Aneurysm: Inpatient Mortality



Source: Chart data from the University HealthSystem Consortium

Unruptured Aneurysm: Volume & Length of Stay (CMI Adjusted)



Source: Chart data from the University HealthSystem Consortium

Stroke Core Measures

GWTG Measure	Goal	2011	2012	2013	2014	2015
STK-1 - VTE Prophylaxis	85%	97.7%	99.3%	99.11%	99.92%	100.00%
STK-2 - Discharged on Antithrombotic Therapy	85%	100%	99.4%	98.83%	99.59%	99.47%
STK-3 - Anticoagulation Therapy for Atrial Fib./Flutter	85%	100%	99%	97.93%	98.09%	98.71%
STK-4 - Thrombolytic Therapy	85%	95.4%	97.9%	97%	94.62%	100.00%
STK-5 - Antithrombotic Therapy by End of Hospital Day 2	85%	97.3%	94.9%	92.88%	97.92%	98.98%
STK-6 - Discharged on Statin Medication	85%	94.5%	98.2%	98.22%	99.22%	99.27%
STK-8 - Stroke Education	85%	92.96%	94.91%	96.2%	97.36%	98.45%
STK-10 - Assessed for Rehabilitation	85%	97.36%	99.41%	99.29%	99.91%	100.00%

Source: Chart data based on fiscal year

Children's Neuroscience

Pediatric neurosurgeons David Sandberg, M.D., FAANS, FACS, FAAP, and Manish Shah, M.D., have added strength to the Children's Neuroscience Center at the Mischer Neuroscience Institute. Dr. Sandberg is a national leader in developing novel techniques to treat malignant brain tumors in children. Prior to his arrival to Houston, he performed translational studies that demonstrated the safety of infusing chemotherapeutic agents directly into the fourth ventricle to treat children with malignant brain tumors in this location. The promising results of these studies have led to a pilot clinical trial, which Dr. Sandberg leads as principal investigator, in collaboration with The University of Texas MD Anderson Cancer Center.

Dr. Shah was recruited from Washington University in St. Louis after completing his fellowship at St. Louis Children's Hospital under world-renowned pediatric neurosurgeon Tae Sung Park, M.D. His special expertise in the surgical management of spasticity and dystonia in children led to his appointment as director of pediatric spasticity and movement disorder surgery at Children's Memorial Hermann Hospital. Dr. Shah performs selective dorsal rhizotomies, baclofen pump placement and advanced deep brain stimulation. He is also an expert in pediatric epilepsy, craniofacial surgery and craniocervical spine surgery.

To avoid the many complications of ventriculoperitoneal shunting for children with hydrocephalus, pediatric neurosurgeons affiliated with the Institute frequently perform minimally invasive endoscopic techniques such as third ventriculostomy, septostomy, choroid

plexus coagulation and fenestration of arachnoid cysts. Selected brain tumors can be biopsied or removed completely via endoscopic techniques. All of these procedures are performed through very small incisions with minimal hair shaving. In collaboration with otolaryngologists affiliated with Memorial Hermann-Texas Medical Center, neurosurgeons also remove some tumors via endoscopic transnasal approaches without an external incision.

Pediatric neurosurgeons at the Mischer Neuroscience Institute are important members of The Fetal Center at Children's Memorial Hermann Hospital, a national leader in providing diagnosis, treatment and complete care for mothers with high-risk pregnancies and infants with congenital anomalies or genetic conditions. The multidisciplinary team performed the first fetal spina bifida repair in the region, and patients are now being referred to the Center for fetal myelomeningocele repair from throughout Texas and a number of surrounding states. Stephen Fletcher, D.O., leads fetal pediatric neurosurgery efforts.

In collaboration with nationally recognized craniofacial plastic surgeons, pediatric neurosurgeons affiliated with Children's Memorial Hermann Hospital perform both conventional and minimally invasive endoscopic surgeries to repair craniosynostosis and other complex craniofacial anomalies. The multidisciplinary Texas Cleft-Craniofacial Team was established in 1952 and has been a regional leader for pediatric craniofacial surgery for decades.



The Mischer Neuroscience Institute is also a center of excellence for pediatric epilepsy surgery and comprehensive specialized care for children with intractable epilepsy. The pediatric Epilepsy Monitoring Unit is the largest and most comprehensive of its kind in the southwestern United States. In addition to MRI and CT with low radiation dose protocols for pediatric patients, affiliated physicians use the Elekta Neuromag® for noninvasive functional mapping of brain activity with magnetoencephalography (MEG) to locate the source of epileptic seizures and minimize risk for children undergoing resective surgery for refractory epilepsy. For the most accurate diagnosis they also use stereo EEG, video EEG, PET, SPECT, memory and speech (Wada) testing, and neuropsychological testing.

Interventions include medical management and the ketogenic diet as well as surgery, including vagus nerve stimulation and laser ablation procedures. Nitin Tandon, M.D., directs the epilepsy surgery program. Manish Shah, M.D., is the pediatric neurosurgeon for pediatric epilepsy surgery. Gretchen Von Allmen, M.D., is chief of pediatric epilepsy for the Texas Comprehensive Epilepsy Program and medical director of the Children's Memorial Hermann Hospital Pediatric Epilepsy Monitoring Unit. Along with pediatric epileptologists Jeremy Lankford, M.D., and Michael Watkins, M.D., they work together with other adult and pediatric epilepsy specialists to manage patients over their entire lifespan for a seamless transition of care.

Three other centers of excellence focus on West syndrome, dysautonomia, and neurometabolic and mitochondrial disorders. The West Syndrome Center of Excellence opened in 2014, with a generous philanthropic gift from the West Syndrome Foundation, and now attracts patients from around the world for treatment of West syndrome. Co-directors Ian J. Butler, M.D., and Gretchen Von Allmen, M.D., lead research on the causes of the syndrome and related pediatric epilepsy disorders and work to increase awareness of the disease.

Dr. Butler and pediatric cardiologist Mohammed Numan, M.D., are co-directors of the Dysautonomia Center of Excellence. The two physicians work together to create individualized treatment plans for each patient based on the most advanced modalities. Mary Kay Koenig, M.D., directs the Mitochondrial Center of Excellence, where affiliated physicians provide comprehensive services to aid in the diagnosis and management of neurometabolic and mitochondrial disorders.

Children's Memorial Hermann Hospital is a leading-edge center for the treatment of retinoblastoma, a rare pediatric eye malignancy that affects only 250 to 350 new patients each year. It is one of a handful of hospitals in the United States at which physicians offer intra-arterial chemotherapy, the most modern treatment for the disease, which enables children to have chemotherapy injected into the arteries that feed the eye, eliminating the side effects of systemic chemotherapy and maximizing the dose to the eye. Treatment of retinoblastoma requires a large multispecialty team that combines endovascular neurosurgery, ocular oncology and medical neuro-oncology working closely together. Physicians affiliated with the Mischer Neuroscience Institute and Children's Memorial Hermann Hospital are also engaged in research investigating new ways to save eyes that have failed conventional therapies.

The Children's Neuroscience Center provides a broad range of diagnostic and treatment services for children with complex neurological problems including autism, brachial plexus disorders, brain tumors and malformations, cerebral palsy, congenital hydrocephalus, craniofacial disorders, developmental disorders, epilepsy, chronic headache and migraine, head trauma, learning disabilities, movement disorders, myopathy, neurofibromatosis, neurometabolic disorders, neuromuscular disorders, pediatric stroke, peripheral nerve disorders, sleep disorders, spina bifida, Tourette syndrome and tuberous sclerosis complex. Physicians affiliated with the Center have specialized pediatric neurosurgical expertise in congenital malformations, including Chiari malformation; endoscopic neurosurgery; and treatment for pediatric stroke, spinal deformities, and traumatic brain and spine injury.

Care at Children's Memorial Hermann Hospital is delivered in a child-friendly, reassuring environment to promote wellbeing and the best possible outcomes. When surgery is required, affiliated physicians use advanced imaging techniques and minimally invasive procedures that lower patient risk. Onsite sedation is available for imaging studies with care provided by specially trained pediatric anesthesiologists and pediatric nurses.

RESEARCH HIGHLIGHT

Methotrexate Infusion Directly into the Fourth Ventricle in Children with Malignant Fourth Ventricular Brain Tumors: A Pilot Clinical Trial

PRINCIPAL INVESTIGATOR: **David I. Sandberg, M.D.**

Director, Pediatric Neurosurgery, Mischer Neuroscience Institute

Professor, The Vivian L. Smith Department of Neurosurgery

Associate Professor, Department of Pediatric Surgery, UTHealth Medical School

For the first time in humans, methotrexate was infused into the fourth ventricle in children with recurrent, malignant brain tumors. A catheter was surgically placed into the fourth ventricle and attached to a ventricular access device. Cerebrospinal fluid (CSF) flow was confirmed by CINE MRI postoperatively. Each cycle consisted of 4 consecutive daily methotrexate infusions (2 milligrams). Disease response was monitored with serial MRI scans and CSF cytologic analysis. Trough CSF methotrexate levels were sampled.

Five patients (3 with medulloblastoma and 2 with ependymoma) received 18, 18, 12, 9, and 3 cycles, respectively. There were no serious adverse events or new neurological deficits attributed to methotrexate. Two additional enrolled patients were withdrawn prior to planned infusions due to rapid disease progression. Median serum methotrexate level four hours after infusion was 0.04 micromoles per liter ($\mu\text{mol/L}$). Range was 0.02 - 0.13 $\mu\text{mol/L}$. Median trough CSF methotrexate level 24 hours after infusion was 3.18 $\mu\text{mol/L}$ (range 0.53 - 212.36 $\mu\text{mol/L}$). All three patients with medulloblastoma had partial response or stable disease until one patient had progressive disease after cycle 18. Both patients with ependymoma had progressive disease after 9 and 3 cycles, respectively.

In conclusion, low-dose methotrexate can be infused into the fourth ventricle without causing neurological toxicity. Some patients with recurrent medulloblastoma experience a beneficial anti-tumor effect both within the fourth ventricle and at distant sites.

Epilepsy

Over the past two years, the Texas Comprehensive Epilepsy Program, the leading program in the southwestern United States for the diagnosis and treatment of epilepsy in patients of all ages, has seen phenomenal growth both in volumes of medically and surgically treated patients and in numbers of faculty. Affiliated physicians now include six full-time adult and three full-time pediatric epileptologists. A collaborative effort between Memorial Hermann-Texas Medical Center, Children's Memorial Hermann Hospital and UTHealth Medical School, the program is the premier Level IV National Association of Epilepsy Centers-certified program in Houston.

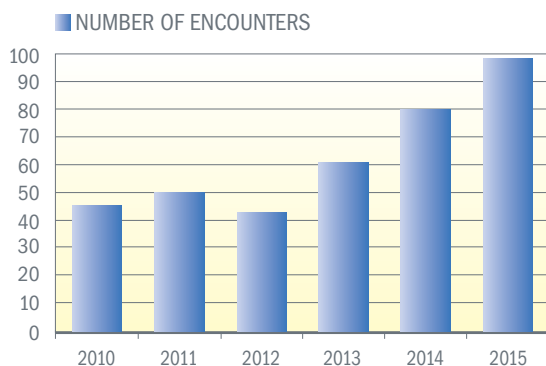
At the heart of the program is a state-of-the-art 12-bed Epilepsy Monitoring Unit (EMU), the largest and most comprehensive unit of its kind in the region. Affiliated physicians deploy a complete set of established and emerging diagnostic technologies that provide comprehensive datasets to help define and localize

the seizure network in the brain. The full suite of diagnostic tools includes magnetoencephalography (MEG) to map both seizure networks and neurological function, video EEG, 3-Tesla structural MRI, functional MRI and diffusion tensor tractography, positron emission tomography (PET), single-photon emission computed tomography (SPECT), memory and intra-carotid amygdala (Wada) testing and in-depth neuropsychological testing. The Texas Comprehensive Epilepsy Program is a national leader in combining the use of MEG and functional MRI to map the brain and record brain activity. It operates one of only a few inpatient units in the country with the capability to perform electroencephalography and polysomnography simultaneously.

The number of patients affiliated physicians treat annually continues to grow. Board-certified neurologists and neurosurgeons diagnose and treat more than 1,800 pediatric and adult patients each year for seizure disorders. Genetic anomalies, brain trauma, structural abnormalities, stroke and brain tumor rank among the top underlying causes of epilepsy, but because seizures manifest differently among individuals, specific determination of the origin of seizures is crucial to planning the most effective treatment for individual patients.

Once a diagnosis is made, physicians offer the most advanced treatment options available, including drug therapy, the ketogenic diet, vagus nerve stimulation (VNS), focal cortical resection, lobectomy, hemispherectomy and corpus callosotomy. The program's surgical complication

Epilepsy Surgery Volumes



Source: Chart data based on patient encounters per calendar year



rates have remained extremely low over the past nine years. At the current time, the Institute's affiliated epilepsy surgeon has performed more than 500 craniotomies for the treatment of epilepsy, with a zero percent mortality rate and a very low rate of permanent morbidity. Additionally, the program goes beyond the medical and surgical treatment of epilepsy by offering counseling to patients to help them cope with their diagnosis. Specialized counselors ensure that recently diagnosed patients have the emotional support they need.

Affiliated physicians are also leaders in innovative surgical approaches for epilepsy, with new surgical approaches and technologies implemented in the past two years, including stereoelectroencephalography (SEEG), robotic SEEG and MR-guided laser interstitial thermal therapy (Visualase®). The Mischer Neuroscience

Institute is a pioneering site for the latter technique – the application of laser surgery for well-delineated focal epilepsies – with carefully selected patients treated in a highly advanced, minimally invasive fashion that ablates the seizure focus. In addition to using the Visualase technique for the treatment of temporal lobe epilepsy associated with hippocampal sclerosis, physicians use it in novel ways, including the ablation of deep-seated periventricular nodular heterotopias.

The program is the second epilepsy program in the country to perform robotic SEEG, a technique that helps localize the seizure focus with precision and in a minimally invasive fashion. The safety and efficacy data reported by affiliated physicians following all types of surgical intervention for epilepsy are excellent. They will also be initiating treatment with

a newly FDA-approved technique for responsive neuromodulation (NeuroPace®).

The epilepsy team has been involved in cutting-edge research related to most epilepsy treatments approved in the United States in the last 15 years, including a number of pharmacological therapies and VNS therapy. Current drug trial research includes lacosamide monotherapy and adjunctive therapy for partial-onset seizures; an open-label extension study of rufinamide as an adjunctive therapy in patients with refractory partial-onset seizures; and vigabatrin therapy for refractory focal epilepsy.

Faculty at UTHealth Medical School pursue several other lines of clinical and scientific research, such

as the use of tractography to lateralize temporal lobe epilepsy and to delineate the epileptogenic network; oxygen-enhanced magnetic resonance imaging in non-lesional focal epilepsy; correlation of waking background alpha frequency with measures of attention and reaction; and the use of intracranial electrocorticography to study a variety of cognitive and language processes. Research funding for faculty comes from a variety of sources, including major National Institutes of Health and National Science Foundation grants; in addition, they pursue collaborative interdisciplinary research with a number of other local institutions. The program is also a member of the National Critical Care EEG Monitoring Research Consortium (CCEMRC) and has contributed patient data to national projects.



Minimally Invasive Localization and Treatment of Focal Epilepsy: A Paradigm Shift

LEAD PHYSICIAN: **Nitin Tandon, M.D.**, Professor, Vivian L. Smith Department of Neurosurgery, UTHealth Medical School

Introduction: The combination of a minimally invasive approach – stereo-electroencephalography (SEEG) with MRgLITT – theoretically provides epilepsy surgeons with the capability to identify and destroy a seizure focus without the performance of a craniotomy. This approach represents a paradigm shift in the treatment of focal intractable epilepsy. The researchers reported on a series of patients who were managed by this approach at the Mischer Neuroscience Institute and evaluated the decision process, the surgical strategy, the risks and the outcomes of such an approach.

Methods: The researchers used a prospectively compiled database of patients undergoing surgical interventions for medically intractable epilepsy at the Texas Comprehensive Epilepsy Program to identify patients who underwent minimally invasive procedures for epilepsy. These included all patients undergoing MRgLITT or SEEG procedures over a two-year interval.

Demographic data relating to all patients – types of and seizure frequency, age at the onset of seizures and at surgery, preoperative anticonvulsants, number of depth electrodes or laser ablation probes placed, and duration of intracranial monitoring – were compiled from the medical records. All patients were carefully monitored for complications related to electrode placement (hemorrhage, swelling or infection), and were followed after the removal of electrodes until either the decision for no surgery, additional electrode placement or resection was made. All patients undergoing resection were followed for as long as possible and the neurological as well as the seizure outcomes were compiled.

Results: Over a two-year interval, 75 patients underwent 70 SEEG procedures and 30 patients underwent MRgLITT procedures. Of these, 15 patients underwent localization of the seizure focus using SEEG techniques, followed then by MRgLITT using the Visualase® system. The mean age at the time of intervention was 37.5 years (range 18-61 years). Mean age at seizure onset was 19 years (range 1-58). All patients had failed at least 2 medications prior to surgical intervention. The mean age at seizure onset was 13 years; age at implantation was 28 years.

Follow-up post resection/ablation of at least 3 months duration was available for the first 36 patients (37 procedures). Of the 36 patients, 29 (80.5%) underwent resections (4 had SDE placement after SEEG) and 7 underwent no resections – seizure foci were multifocal or not localizable. Of these 29 patients, three underwent MR-guided laser interstitial thermal ablation using the Visualase system and two others underwent MRgLITT in addition to an open resection.

Of the six patients of interest here, three underwent MRgLITT of the L hippocampus and amygdala, one underwent a traditional right temporal lobe resection followed by ablation of PVNH, while one patient underwent a parietal neocortical resection followed by right medial temporal ablation. Five patients had an Engel 1a outcome (ILAE class1) and one had an Engel 3a (ILAE class 4) outcome. One of the patients (seizure free at 4 months post ablation) was a victim of homicide unrelated to the epilepsy.

Memory Disorders and Dementia

Physicians affiliated with the Neurocognitive Disorders Center evaluate and treat patients with concerns about memory, language, judgment, mood, behavior and related issues. Because symptoms may have a range of causes – normal aging, early dementia, mini-strokes, infections, vitamin deficiencies, depression, hormonal deficiencies and sleep disorders, among others – they evaluate symptoms fully to ensure correct treatment. Several important advances are allowing them to determine a specific diagnosis in most patients, leading to better treatments. Research at the Center focuses on three key areas for dementia: improving diagnosis, determining its causes and improving treatment,

either by preventing dementia or treating it in the early symptomatic stage.

Under the direction of neurologist Paul Schulz, M.D., the Mischer Neuroscience Institute was the first in Houston to diagnose Alzheimer's disease (AD), using amyloid-sensitive PET imaging, which is helpful in determining whether patients do or do not have AD. Now physicians are working with laboratory scientists to develop new spinal fluid and blood tests for AD and Parkinson's disease (PD), and new imaging agents that will help diagnose other forms of dementia and provide insights into their underlying processes. They are also using blood and spinal fluid to



RESEARCH HIGHLIGHT

investigate the role of genetic mutations and chemical modifications of genes in dementia.

Neurodegenerative diseases affect millions of Americans, and their causes remain uncertain. While there is a known hereditary component to AD, PD, amyotrophic lateral sclerosis (ALS) and frontotemporal disease (FTD), most patients with these disorders do not have a family history. Based on this knowledge, physicians suspect that environmental risk factors may increase vulnerability to the disorders. Investigators at the Neurocognitive Disorders Center are examining how certain risk factors may lower the threshold for dementia, including traumatic brain injury, posttraumatic stress disorder (PTSD) and transmissible components. They are also investigating whether chemical modifications of genes, caused by these risk factors, may lead to dementia.

Several pioneering studies are under way at the Center, including multicenter clinical trials of two promising medications added to the treatment regimen of patients currently taking donepezil; both medications have unique mechanisms of action previously unstudied. Other trials are investigating the efficacy of deep brain stimulation in patients with major depressive disorder who have not responded to other treatments; developing stem cells for use in patients with neurodegenerative disorders; and determining whether removing amyloid, a protein deposited abnormally in the brains of people with AD, from the blood of patients with early AD will reduce the overall amount of amyloid in the brain.

Investigating a New Treatment for Alzheimer's Disease

PRINCIPAL INVESTIGATOR: **Paul Schulz, M.D.**

Professor, Department of Neurology, UTHealth Medical School

Alzheimer's disease (AD) affects millions of Americans. Despite hundreds of medication trials, no treatment has been shown thus far to alter its course. Researchers at the Neurocognitive Disorders Center are studying the effect of placement of human AD genes in a mouse model.

Pathologic amyloid is deposited in the brains of mice such that by 13 months of age, the mice exhibit memory loss, and amyloid is easily detected in brain tissue samples. Investigators remove blood once per month and give the animals blood from mice without the AD genetic mutations. When examined at 13 months post transfusion, the AD mice showed 80 percent less amyloid in their brains than the untreated mice, and their memory was the same as the control animals. The researchers are now translating the laboratory finding to humans with AD, testing whether removing blood amyloid leads to reduced brain amyloid and improves outcomes in patients with AD. To date, 31 control patients have been examined to determine whether the treatment alters blood levels of amyloid, and to determine the optimal frequency of treatments. Dr. Schulz and his team are now studying patients with AD.

Movement Disorders and Neurodegenerative Diseases

Using pioneering techniques and clinical expertise to diagnose, evaluate, manage and treat adult and geriatric patients, the Movement Disorders and Neurodegenerative Diseases Program, called UT MOVE, has established a track record of providing outstanding care and

management for patients. A collaboration of the Memorial Hermann Mischer Neuroscience Institute and UTHealth Medical School, the UT MOVE program provides patients with specialty clinics and faculty expertise in spasticity management, deep brain stimulation, neurotoxin injection therapy, Huntington's disease, Parkinsonian disorders, disorders of tremor, ataxia and those caused by traumatic brain injury.

The Spasticity Management Clinic offers pharmacological and surgical therapies, including the use of intrathecal baclofen pump therapy. Through the Deep Brain Stimulation (DBS) Clinic, candidates are selected for DBS therapy for the FDA-approved indications of Parkinson's disease, tremor and dystonia, which includes team management and programming of DBS therapy. At the Neurotoxin Injection Therapy Clinic, physicians use Botox®, Xeomin®, Myobloc® or Dysport® as indicated for abnormal states of dystonia, spasticity, chronic migraine and back pain. The newly created multidisciplinary Huntington's Disease (HD) Clinic for the diagnosis, management and support of patients and their families with Huntington's disease – the only such specialty clinic in the Houston area – is headed by Erin Furr-Stimming, M.D. In addition, expertise in the management of traumatic brain injury is available in collaboration with the Halle Center for Traumatic Brain



RESEARCH HIGHLIGHT

Injury and the joint appointment of Allison Boyle, M.D., to the UT MOVE team of physicians. In 2015, a new bimonthly, full-day UT MOVE clinic was established at Memorial Hermann The Woodlands Hospital, providing the same expert care available in the Texas Medical Center to this fast-growing community.

The movement disorders medical team uses proven and investigational medications and interventional methods to manage Parkinson's disease, Parkinsonian disorders, generalized and focal dystonia, essential tremor and other tremor states, Huntington's chorea, restless leg syndrome and other sleep disorders like REM sleep behavior disorder, cortical and subcortical dementias, cerebral palsy, spasticity, ataxias, gait disorders, spinal and brain trauma-related movement abnormalities, multiple sclerosis-related movement abnormalities and other inherited and acquired neurodegenerative diseases. The team's treatment philosophy is grounded in the early identification of disease and early use of neuromodulating or neuroprotective approaches. Physicians maintain patients at the highest level of function possible, based on symptom-driven therapeutic goals set by the physician and patient. In developing and adjusting treatment plans, they consider the whole person, as well as the patient's environment and support groups. They also emphasize education, and encourage patients to stay mentally and

Enroll-HD: A Prospective Registry Study in a Global Huntington's Disease Cohort

PRINCIPAL INVESTIGATOR: **Erin Furr-Stimming, M.D.**
Assistant Professor, Department of Neurology,
UTHealth Medical School

Enroll-HD is a longitudinal, observational, multinational study that will integrate two existing Huntington's disease (HD) registries, REGISTRY in Europe and COHORT in North America and Australia, while also expanding to include sites in Latin America and Asia. With no end date and annual assessments, the goal of Enroll-HD is to build a large and rich database of longitudinal clinical information and biospecimens. This database will serve as a basis for future studies aimed at developing tools and biomarkers for progression and prognosis, identifying clinically relevant phenotypic characteristics, and establishing clearly defined endpoints for interventional studies.

The primary objective of Enroll-HD is to develop a comprehensive repository of prospective and systematically collected clinical research data (demography, clinical features, family history, genetic characteristics) and biological specimens (blood) from individuals with manifest HD, unaffected individuals known to carry the HD mutation or at risk of carrying the HD mutation, and control research participants (spouses, siblings or offspring of HD mutation carriers known not to carry the HD mutation). Enroll-HD is conceived as a broad-based and long-term project to maximize the efficiencies of nonclinical research and participation in clinical research. With more than 200 sites in roughly 30 countries, Enroll HD will be the largest database available for HD researchers.

RESEARCH HIGHLIGHT

Efficacy of Isradipine in Early Parkinson's Disease

PRINCIPAL INVESTIGATOR: **Mya C. Schiess, M.D.**

Professor and Adriana Blood Chair, Department of Neurology, UTHealth Medical School

This Phase III, double-blind, placebo-controlled parallel group study will investigate whether treatment with isradipine is effective in slowing the progression of Parkinson's disease (PD) disability. The investigators expect to enroll 336 participants at approximately 56 sites across the United States and Canada.

Ten milligrams of isradipine will be compared to placebo for treatment of newly diagnosed PD patients. Although isradipine has been approved by the FDA to treat high blood pressure, it is considered investigational in this study. Isradipine can affect the function of specialized channels present in the types of brain cells affected in PD patients. These cells are usually responsible for making dopamine, which is depleted in patients with PD. Isradipine may block the damage caused by the flow of certain chemicals through these channels. Laboratory data has showed that isradipine may prevent the development of Parkinson-like symptoms in animal studies.

The drug has been evaluated in some patients with PD. The first study with isradipine controlled release (CR) in patients with early PD and normal blood pressure found that the drug was reasonably well tolerated and safe. Because the controlled-release formulation of isradipine is not available for use, investigators are using the immediate-release formulation. Eligible participants will be followed for up to 36 months and will be expected to complete 12 in-person visits and four telephone visits. The study visits will include clinical assessment of motor, neuropsychiatric and cognitive testing as well as collection of blood and urine samples.

physically active, to work at having fun and to create a positive environment with friends and family.

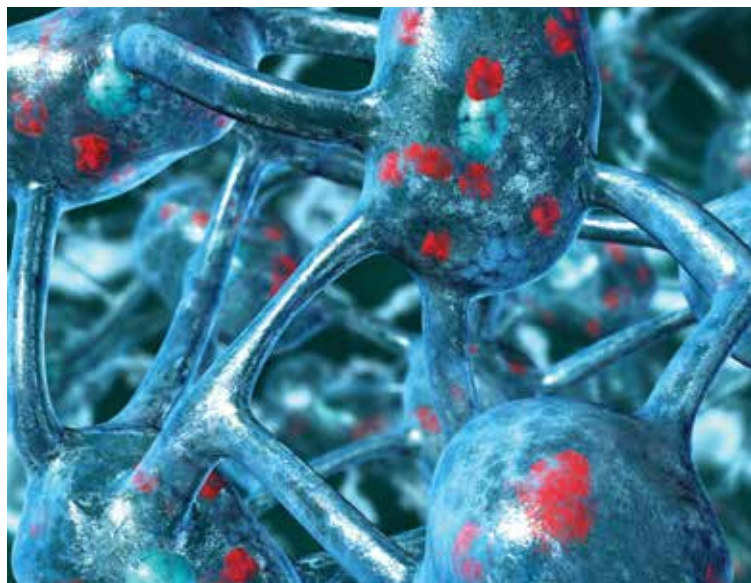
UT MOVE supports and partners with the Houston Area Parkinson's Society (HAPS), which has been crucial in providing educational, exercise and social programs as well as support groups to Parkinsonian patients. The program partners with TIRR Memorial Hermann in a comprehensive UT MOVE/Neurorehabilitation Program that incorporates neurological-driven rehabilitation as part of the treatment approach.

The deep brain stimulation (DBS) program for Parkinson's tremor, dystonia and essential tremor, offered at the Memorial Hermann Mischer Neuroscience Institute at the Texas Medical Center and through Mischer Neuroscience Associates in the community, is known for low complication rates and outstanding outcomes. Based on the skill of neurological and neurosurgical teams and their expertise in DBS programming, Mya Schiess, M.D., director of the Movement Disorders and Neurodegenerative Diseases Program, and her team advocate for early use of deep brain stimulation

in appropriate patients. In 2015, the DBS program recorded record growth, and Dr. Schiess was the only representative from the United States participating in the international Consensus Panel to Formulate Criteria for the Selection of Parkinson's Disease Patients for DBS Therapy. UT MOVE faculty member Raja Mehanna, M.D., has added depth and understanding to the program's legacy in DBS with numerous publications of reviews, articles and a book on DBS therapy and outcomes.

In addition, UT MOVE operates a referral program to serve community neurologists who select patients for deep brain stimulation. UT MOVE physicians provide intraoperative microelectrode recording and electrode stimulation testing to determine and confirm the best DBS placement to reduce disease symptoms. The results are shared with referring neurologists, allowing them to benefit from this information and improve subsequent programming. Following DBS placement, patients are returned to the referring physician.

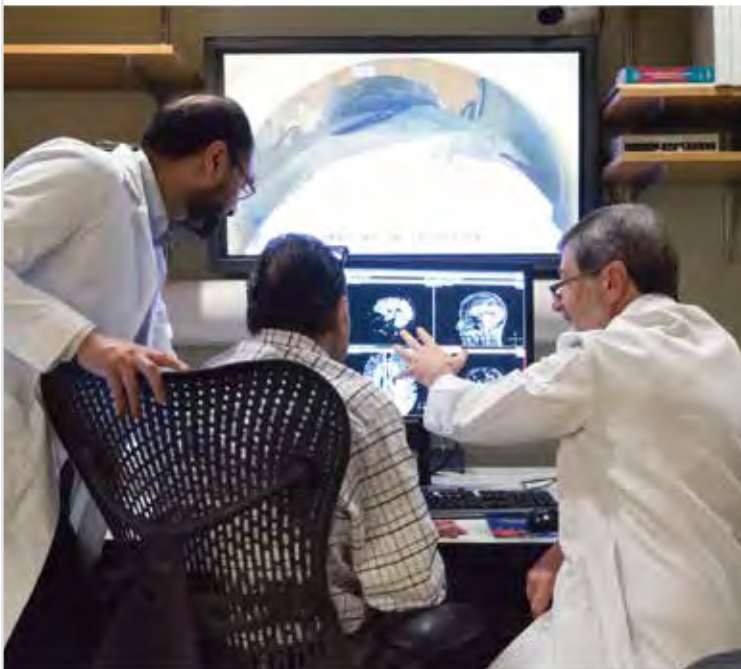
Research within the division of Movement Disorders and Neurodegenerative Diseases at UTHealth Medical School is substantial, with partnerships and collaborations among clinical and basic science studies and multiple disciplines, and funding from federal, pharmaceutical and philanthropic sources. Faculty in the program are members of the Movement Disorders Society, the Parkinson's Study Group, Huntington's Study Group, Tremor Research Group, Dystonia Coalition and Restless Legs Syndrome Study Group. Ongoing established research includes a longitudinal prospective study on biomarkers and pre-symptomatic biomarkers for Parkinsonian syndromes, which led in 2013 to the discovery of immune-mediated markers of disease activity and proposed cell therapy intervention for Parkinsonism. This work is currently undergoing protocol



review and setup for a Phase 1 safety and tolerability clinical pilot trial. Additional research includes a novel medication for Huntington's disease and associated chorea and a Huntington's disease bio repository study. Other endeavors include novel medications for Parkinson's disease and Parkinson's dyskinesia, a novel medication for tardive dyskinesia, a botulinum toxin B trial for sialorrhea and two botulinum toxin trials for cervical dystonia.

This year, the UT MOVE program became a participating site for the multicenter National Institute of Neurological Disorders and Stroke/Stroke/Parkinson Study Group trial of isradipine as a neuroprotective drug in Parkinson's disease. Additionally, the Movement Disorders and Neurodegenerative Diseases program is functioning as a subject in the RECRUIT trial, which is exploring and developing techniques to improve minority recruitment in movement disorders trials.

Multiple Sclerosis



The Multiple Sclerosis Program at the Memorial Hermann Mischer Neuroscience Institute at the Texas Medical Center has established a track record of leading-edge care, using groundbreaking techniques to diagnose, evaluate, manage and treat adult patients with MS and other demyelinating disorders. The scope of expertise of affiliated physicians is broad and includes patients in all stages of MS, as well as those with neuromyelitis optica, transverse myelitis and optic neuritis. They are experienced in the appropriate use of aggressive therapies in severe cases. The Institute is a proud sponsor of the BP MS 150, a two-day fundraising bike ride organized by the National Multiple Sclerosis Society.

Organized in 1983, the Multiple Sclerosis Research Group (MSRG) has participated in numerous clinical trials of novel disease-modifying therapies, serving as the lead center for international studies, several of which were pivotal in gaining FDA approval of currently available treatments for MS. Recently completed research includes a National Institutes of Health-sponsored trial of combined therapy with interferon beta-1a and glatiramer acetate in patients with early relapsing MS (the CombiRx Trial); the safety and efficacy of oral fampridine-SR; detection of MS-related cognitive impairment; the relationship of Epstein-Barr virus and MS; and serial magnetic resonance spectroscopy in MS, among others.

The program was the first in the world to conduct preclinical studies on the effects of combined therapy with immunomodulating drugs. It is the first and only center in Houston to direct national and international clinical trials in MS, and remains the North American leader in studies of primary progressive multiple sclerosis, as well as the most active center in Texas in the conduct of organized clinical trials of new therapies for MS. Affiliated physicians are at the forefront of investigator-initiated research in immune regulation in MS, infection as a cause of MS, MS-related cognitive impairment and MS-related MRI findings.

RESEARCH HIGHLIGHT

In the department of Neurology's state-of-the-art Magnetic Resonance Imaging Analysis Center, physicians use spectroscopic and diffusion tensor imaging with tractotomy, as well as other advanced diagnostic tools. Following diagnosis, patients benefit from breakthrough treatment options that include injectable immunomodulators, immunosuppressives, monoclonal antibodies and all of the newer oral agents designed to treat the debilitating symptoms of MS. Investigators also use the MRI Analysis Center to monitor the effects of promising oral drugs in efficacy trials. The Center was pivotal in providing quantitative imaging data that supported the regulatory approval of the oral agent teriflunomide for use in relapsing forms of MS in the United States, Europe and a growing number of countries worldwide, determining the optimal drug dose and extending the results of its benefits when used in first symptom-onset disease.

The Multiple Sclerosis Program's goal is to maintain patients at the highest level of function possible, with early use of immunoactive agents to prevent disease progression. Because rehabilitation is integral to each patient's treatment plan, affiliated physicians work closely with the physical medicine and rehabilitation specialists and therapists at TIRR Memorial Hermann, a national leader in medical rehabilitation and research, as well as the inpatient neurorehabilitation team at the Mischer Neuroscience Institute.

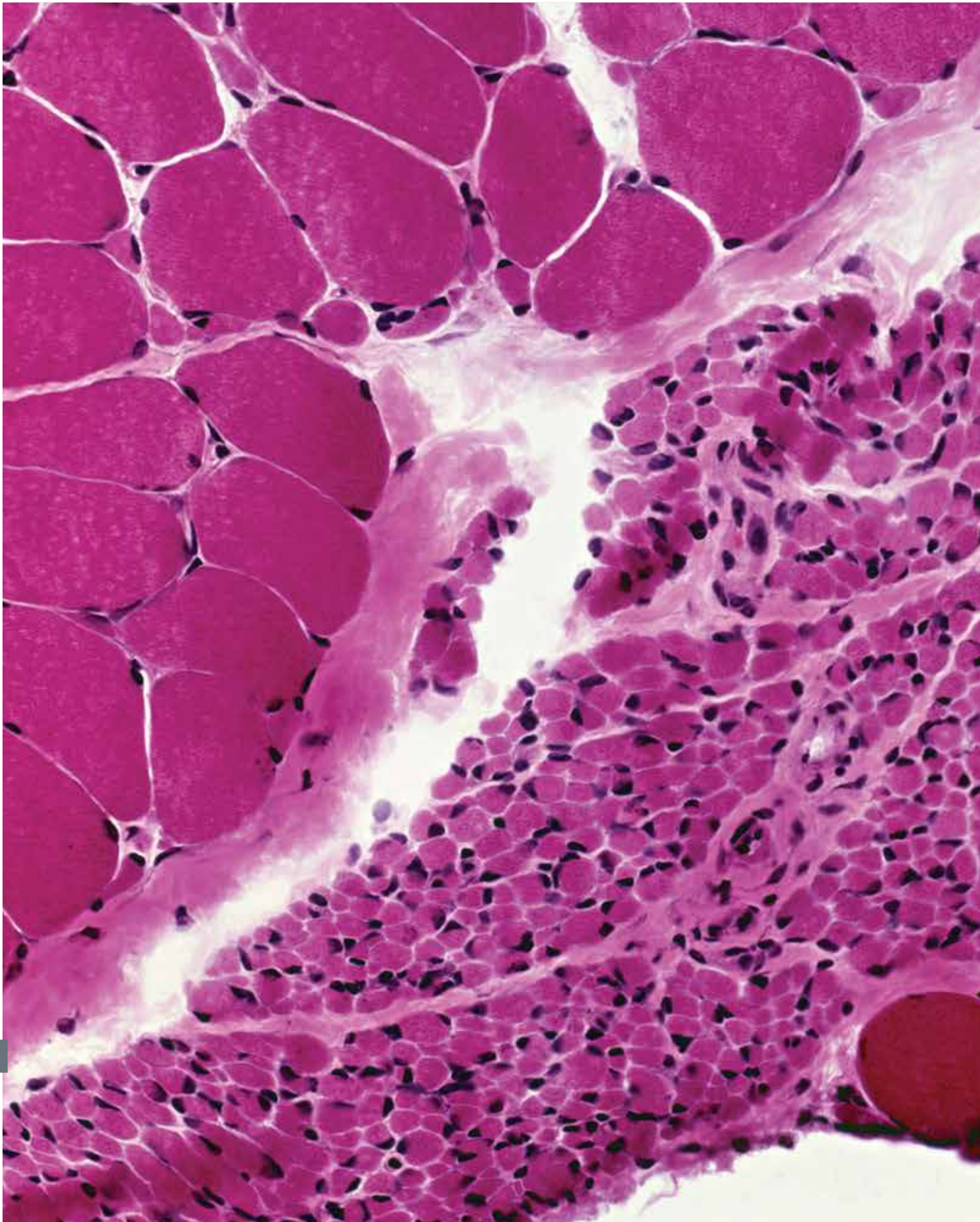
Varicella-zoster Virus Infections in Patients Treated with Fingolimod: Risk Assessment and Consensus Recommendations for Management

In this multicenter study, researchers assessed the incidence, risk factors and clinical characteristics of varicella-zoster virus infections in patients with multiple sclerosis who were treated with fingolimod.

Infection rates among 3,916 clinical trial participants diagnosed with relapsing-remitting MS are based on data pooled from controlled phase 2 and phase 3 studies. These participants received fingolimod at a dosage of 0.5 or 1.25 mg/d, interferon beta 1-a or placebo. The investigators also analyzed data from 3,553 participants in ongoing uncontrolled extension phases, each of whom received fingolimod 0.5 mg/d.

Among participants in the clinical trials, rates of varicella-zoster virus infection were low with fingolimod 0.5 mg/d, but higher than in those randomized to the placebo arm. Rates of infection in the extension phases were similar. Although serious cases of herpes zoster were uncommon, the researchers recommended that patients be followed closely to identify early symptoms and ensure timely treatment.

Ann M. Arvin, M.D., Jerry S. Wolinsky, M.D., Ludwig Kappos, M.D., Ph.D., Michele I. Morris, M.D., Anthony T. Reder, M.D., Carlo Tornatore, M.D., Anne Gershon, M.D., Michael Gershon, M.D., Myron J. Levin, M.D., Mauritz Bezuidenhout, M.Sc., Norman Putzki, M.D., Varicella-zoster Virus Infections in Patients Treated with Fingolimod: Risk Assessment and Consensus Recommendation for Management. *JAMA Neurology* 2015;72:31-9.



Neuromuscular Disorders

Physicians affiliated with the Neuromuscular Disorders Program are subspecialized in complex neuromuscular disorders that are difficult to diagnose and treat, including neurodegenerative disorders, inflammatory nerve and muscle disorders, autoimmune neuromuscular junction disorders, traumatic nerve injuries and toxic metabolic disorders of the peripheral nerves and muscles. The program is a designated center of excellence for Guillain-Barré syndrome (GBS) and chronic inflammatory demyelinating polyneuropathy (CIDP) and records more than 4,000 patient visits annually, primarily adults age 18 and older. About two-thirds of patients seen by affiliated physicians are over the age of 50.

Neurodiagnostic facilities include a state-of-the-art Electromyography (EMG) Laboratory and a Muscle and Nerve Laboratory. The EMG Lab provides comprehensive nerve conduction studies and EMG evaluations performed by expert staff.

Because electrodiagnostic evaluation is an extension of clinical findings, our medical specialists perform a focused neuromuscular examination, including history and physical, before conducting the electrical test. In addition to nerve conduction and EMG, electrodiagnostic studies available at the lab include repetitive nerve stimulation, blink reflexes, cranial nerve studies, single-fiber electromyography and facial/trigeminal neuropathy. An invaluable diagnostic test, EMG provides evidence in support of diagnoses of peripheral neuropathies; motor neuron diseases such as amyotrophic lateral sclerosis and spinal muscular atrophy; muscle disorders such



as myopathy and muscular dystrophy; neuromuscular junction disorders such as myasthenia gravis; entrapment neuropathies such as carpal tunnel syndrome, ulnar and peroneal neuropathies; and traumatic nerve injury, including evaluation of the brachial plexus and facial neuropathy. The Neuromuscular Disorders Program is the only program in Houston that provides single-fiber EMG.

Studies conducted in the Muscle and Nerve Laboratory help improve diagnosis in cases with limited neuromuscular findings by locating abnormalities at a pathologic/microscopic level. Affiliated subspecialists perform muscle, nerve and skin biopsies, which are further processed by highly experienced staff. Their preferred technique is open biopsy under local anesthesia,

RESEARCH HIGHLIGHT

International GBS Outcome Study (IGOS): A Prospective INC Study on Clinical and Biological Predictors of Disease Course and Outcome in Guillain-Barré Syndrome (GBS)

PRINCIPAL INVESTIGATOR: **Kazim Sheikh, M.D.**

Professor, Department of Neurology, UTHealth Medical School

Guillain-Barré Syndrome is a post-infectious immune-mediated polyradiculoneuropathy with a highly diverse clinical course and outcome. Despite partially effective forms of treatment (immunoglobulins and plasma exchange), outcomes in patients with GBS have not improved in the last two decades. At present about 10 to 20 percent of patients remain severely disabled and about 5 percent die. One explanation for this stagnation is the highly variable clinical course of GBS and the lack of knowledge about the factors that determine the clinical course in individual patients.

This study aims to identify clinical and biological determinants and predictors of disease course and outcome in individual patients with Guillain-Barré syndrome, as early as possible after the onset of disease. This information will be used to understand the diversity in clinical presentation and response to treatment of GBS. It will also be used to develop new prognostic models to predict the clinical course and outcome accurately in individual patients with GBS.

Criteria for inclusion in this international multicenter clinical trial include patients with GBS and variants of GBS, including Miller Fisher syndrome (MFS) and overlap syndromes. Males and females of all ages are eligible, independent of disease severity and treatment; inclusion is within two weeks of onset of weakness.

which reduces the likelihood of missing abnormalities in cases of patchy involvement, such as in inflammatory myopathies. They also perform skin biopsies for the diagnosis of small-fiber neuropathy, and the lab is the only center in Houston that processes skin biopsy specimens for the diagnosis of small-fiber neuropathies.

Current research is focused on developing new strategies to treat neuropathic disorders and enhance nerve repair. With funding from the National Institutes of Health and the GBS/CIDP Foundation International, affiliated investigators are evaluating the role and pathogenic mechanisms of anti-ganglioside antibodies

in autoimmune neuropathy; using diffusion tensor imaging to assess and quantify nerve degeneration and regeneration in patients with traumatic nerve injuries; investigating modulation of FcRn as a strategy to prevent autoantibody-mediated nerve injury; examining the pathobiologic effects of anti-ganglioside antibodies on nerve regeneration; and using monoclonal antibodies for delivery of cargo to nerve cells for peripheral nerve imaging and modulation of function.

Neurorehabilitation

Patients recovering from neurological illness or injury benefit from innovative neurorehabilitative technology and integrated care at the Memorial Hermann Mischer Neuroscience Institute at the Texas Medical Center and TIRR Memorial Hermann. Subspecialists affiliated with both facilities are experts in the treatment and rehabilitation of traumatic brain injury, spinal cord injury, stroke, brain and spinal tumors, and other neurological disorders such as multiple sclerosis, Parkinson's disease and Guillain-Barré syndrome.

MISCHER NEUROREHABILITATION

Mischer Neurorehabilitation's clinical, research and education programs are led by neurorehabilitation specialist Nneka Ifejika, M.D., an award-winning author, mentor and reviewer in the fields of neurology and psychiatry. In 2010, she received a grant from the National Institute of Neurological Disorders and Stroke (NINDS) to study the impact of intravenous thrombolysis and healthcare-associated infections on rehabilitation care. Within a two-year period, she published five articles in peer-reviewed journals and received the American Academy of Physical Medicine and Rehabilitation Best Neurological Research Award.

Under Dr. Ifejika's direction, Memorial Hermann-Texas Medical Center's 10-bed inpatient neurorehabilitation unit provides comprehensive rehabilitation care, consisting of an intensive program of physical therapy, occupational therapy and speech-language pathology. The program is distinguished from others by its focus



on incorporating clinical research in stroke prevention and health disparities in the rehabilitation setting.

Patients and families are an integral part of the Neurorehabilitation Program. Upon admission, they discuss their goals with an interdisciplinary team, and together, they develop a treatment plan designed to help the patient reach the highest possible level of function. Mischer Neurorehabilitation provides innovative and evidence-driven rehabilitation by blending manual and technologic therapies, including Korebalance™, Bioness® and IREX® Virtual Reality.

RESEARCH HIGHLIGHT

Swipe Out Stroke (SOS): Feasibility of Using a Consumer-based Electronic Application to Improve Compliance with Weight Loss in Obese Minority Stroke Patients

PRINCIPAL INVESTIGATOR: **Nneka L. Ifejika, M.D.**

Director of Neurorehabilitation, Mischer Neuroscience Institute

Assistant Professor, Department of Neurology, UTHealth Medical School

Background: Minority compliance with obesity management has been a long-standing concern in the stroke community. Unfortunately, structured weight loss programs are expensive, and compliance significantly decreases upon program completion. Information technology is an innovative, cost-effective way to bridge this gap. Minorities spend more than \$4.5 billion annually on consumer electronics, making studies that utilize media consumption ideal for health outreach and health promotion efforts in minority communities. Many patients would benefit from an electronic application that facilitates personal contact, provides positive reinforcement and gives support using a low-cost, smartphone-based platform.

To date, there are no studies evaluating the feasibility of using a consumer-based electronic application (CBEA) to improve compliance with weight loss in high-risk, obese minority stroke patients. This proposal will address this critical gap by examining whether such an intervention will improve adherence with weight loss measures, thereby improving related vascular risk factors, such as hypertension, in patients within the critical first six months post stroke.

Objectives: The study will evaluate the feasibility (dropout rate and adherence) of using a physician-monitored CBEA to improve weight loss in obese minority stroke patients compared to usual care. The investigators hypothesize that participants who are randomized to the CBEA group will have a lower dropout rate and higher adherence to the weight loss intervention compared to usual care. The second aim of the study is to examine percentage weight loss in the CBEA group and the usual care group, based on the hypothesis that patients who use the physician-managed CBEA will have a larger percent weight loss at six months compared to usual care. Results from this study will have broader implications for translation to other conditions correlated with obesity that have increased incidence in the minority community, e.g., myocardial infarction. The National Institute of Neurological Disorders and Stroke (NINDS) has developed a health disparities division, which has a paucity of Phase I minority-initiated trials. This pilot study will provide critical information with the potential to inform an efficacy study.



Affiliated physicians provide outstanding patient care and conduct award-winning research on the underlying conditions that impact rehabilitation progress, applying their advanced knowledge directly to the care of each patient they serve. This level of advanced training is a critical component of the rehabilitation process, particularly as Mischer Neurorehabilitation serves as an extension of the Mischer Neuroscience Institute's world-renowned vascular neurology and neurosurgical programs. Because they are trained in the administration of the National Institutes of Health Stroke Scale and the modified Rankin Scale, used by vascular neurologists to assess stroke deficits and post-stroke disability, they can directly interpret acute neurologic changes and communicate across disciplines without the need for outside consultation. This combination of clinical excellence and research innovation makes the Mischer Neurorehabilitation team a leader in the post-acute treatment of neurologic conditions.

TIRR MEMORIAL HERMANN

An international leader in rehabilitation and research for 56 years, TIRR Memorial Hermann is a model for interdisciplinary rehabilitation services, patient care, education and research. The hospital's Brain Injury and Stroke Program has been designated a Traumatic Brain Injury Model System (TBIMS) with funding from the National Institute on Disability and Rehabilitation Research (NIDRR) since 1987, and is one of only 16 in the nation. For 26 consecutive years, *U.S. News & World Report* has named the hospital to its list of "America's Best Hospitals." In 2015, TIRR Memorial Hermann ranked as No. 2 in the nation.

Many of the world's leading physicians in rehabilitation medicine provide care at TIRR Memorial Hermann. The patient care environment, which blends passionate staff, exemplary care and a commitment to overall quality of life, distinguishes TIRR Memorial Hermann. Rehabilitation teams at the facility transform lives and inspire hope

RESEARCH HIGHLIGHT

Advanced Myoelectric Control for Neurologic Injury Rehabilitation

PRINCIPAL INVESTIGATOR: **Ping Zhou, Ph.D.**

*Director, NeuroMyo Engineering for Rehabilitation Laboratory, TIRR Memorial Hermann
Associate Professor, Department of Physical Medicine and Rehabilitation, UTHealth Medical School*

Eliminating motor impairments resulting from neurological injuries such as spinal cord injury, hemisphere stroke and cerebral palsy is a key healthcare challenge for modern society. Deficits in upper-extremity motor control often chronically persist. Restoration of voluntary control of muscles serving different upper-limb functions could lead to substantial improvement in quality of life. In Dr. Zhou's previous studies through a novel framework using high density surface electromyogram (EMG) recording and pattern recognition analysis, it was found that high accuracies can be obtained in classification of arm, hand and finger/thumb movements involving the affected limb of neurological injury subjects. Furthermore, the high classification accuracies can be maintained with a very small number of appropriately selected surface EMG channels. This suggests that substantial neural control information is contained in affected muscles, which is readily extracted with advanced EMG signal processing techniques. Such information provides a potentially powerful approach to controlling rehabilitative or assistive devices for neurologic injury rehabilitation.

This study aims to merge innovative methodologies from advanced surface EMG processing and advances in exoskeleton development to assist neurologic injury patients in regaining or improving upper-limb function. A key innovation of the development is the use of EMG pattern recognition to determine intended movement in complex motions used in the activities of daily living. The myoelectric pattern recognition-controlled wearable exoskeleton robot is applied to assist patients in regaining mobility through motor relearning. For each subject, an intensive repetitive training of various upper-limb movements is performed. The effect is evaluated by comparing clinical assessments before and after training. In addition, the researchers monitor motor unit properties before and after a series of training sessions and investigate whether/how motor unit property changes may correlate to robotic training outcomes. Understanding motor unit mechanisms underlying the effective training will provide solid scientific basis for the training and this in turn will help further improvement or refinement of the system.

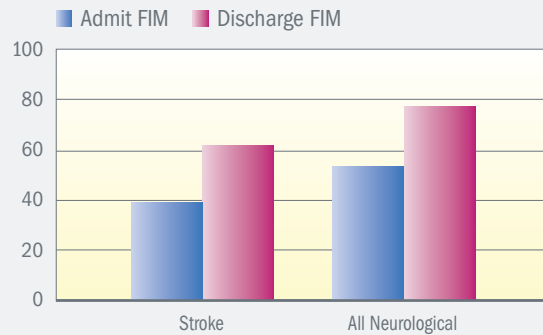
QUALITY & OUTCOMES MEASURES

in people whose lives have been significantly altered by an illness or injury. Because the hospital is part of the Memorial Hermann Health System, patients have access to Memorial Hermann-Texas Medical Center specialists.

The success of rehabilitation depends on multiple disciplines working seamlessly together to set treatment goals and monitor progress. A full interdisciplinary team of highly qualified rehabilitation professionals manages the care of both inpatients and outpatients. Led by a physician, the team also includes physical therapists, occupational therapists, speech therapists, music therapists, rehabilitation nurses, pharmacists, social workers, case managers, dietitians, therapeutic recreation specialists, neuropsychologists and respiratory therapists.

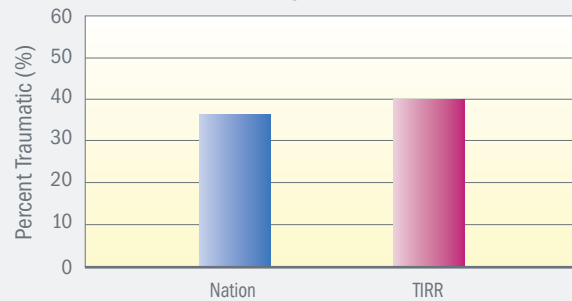
TIRR Memorial Hermann offers comprehensive rehabilitation programs and services that address the individual needs of each patient who has experienced a catastrophic injury or illness. Inpatient rehabilitation programs and services include treatment of stroke, brain injury, spinal cord injury, neurological disorders, Guillain-Barré syndrome, cancer rehabilitation, pulmonary rehabilitation, limb loss, trauma, neurodegenerative diseases and debilitation. Outpatient rehabilitation centers located throughout the city offer programs and services including the Challenge Program (community reentry), physical therapy, occupational therapy, speech-language therapy, cognitive rehabilitation, balance/vestibular, cancer rehabilitation, cognitive rehabilitation, Lee Silverman Voice Treatment (LSVT) (LOUD), LSVT BIG, neurodegenerative therapy, deconditioning, lymphedema management, neuropsychology, pediatrics, functional vision rehabilitation, and swallowing and voice therapy.

Neurorehabilitation: Functional Independence Measure Change



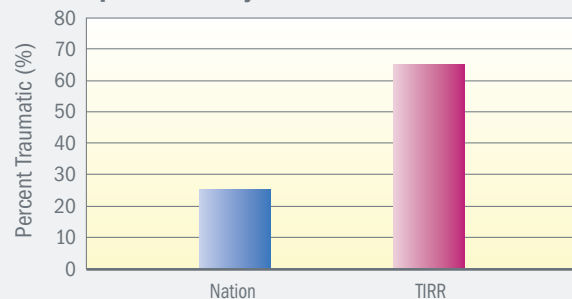
Source: chart data based on calendar year 2014

Traumatic Brain Injuries Treated



Source: chart data based on calendar year 2014

Spinal Cord Injuries Treated



Source: chart data based on calendar year 2014

RESEARCH HIGHLIGHT

Wearable Lower-extremity Exoskeleton to Promote Walking in Persons with Multiple Sclerosis

PRINCIPAL INVESTIGATOR: **Shuo-Hsiu “James” Chang, PT, Ph.D.**

Research Scientist, TIRR Memorial Hermann

Assistant Professor, Department of Physical Medicine and Rehabilitation, UTHealth Medical School

The impaired ability to walk independently is a significant consequence of multiple sclerosis (MS) resulting in substantial limitation in mobility and performance of daily activities that restricts full participation and home and community reintegration. Moreover, the energy expenditure of walking is increased. This additional metabolic demand contributes to fatigue, which promotes a sedentary lifestyle that predisposes to secondary health deterioration and compromised quality of life. Gait training/restoration in MS is necessary but often limited due to the progress and severity of the disease and limitations of traditional strengthening exercises. Developing novel strategies to promote independent walking in this population is essential for health promotion.

Recently, wearable lower-extremity robotic exoskeletons have been developed to restore ambulation in paralyzed or weak individuals with spinal cord injuries and stroke. Exoskeletons are designed to utilize the user's residual active movements, such as body forward and lateral sway, to initiate externally powered stepping for overground walking and climbing stairs. Most importantly, the assistance provided by wearable robotic exoskeletons may reduce energy expenditure during walking and allow persons with MS to recover some degree of independent walking that is more efficient. This can have a profound impact on quality of life.

The purpose of this pilot study is to investigate whether using an exoskeleton could promote recovery of walking in persons with MS. The researchers hypothesize that participants will be able to walk with an exoskeleton and with minimal to moderate trainer assistance after training (Aim 1). They also plan to determine and compare physical and cognitive demands during overground walking with and without the exoskeleton (Aim 2). They hypothesize that physical and cognitive demands will reduce during overground walking with the exoskeleton and especially after training. The reduced physical and cognitive demands will promote energy conservation and prevent or delay fatigue. This wearable exoskeleton provides a unique, innovative opportunity to assist a sustained upright posture and facilitate walking with better energy efficiency in individuals with MS. The investigators expect the exoskeleton to facilitate walking and improve quality of life in people with MS.

TIRR Memorial Hermann has a dedicated international team that works with diverse patient backgrounds and nationalities. The team accommodates a variety of dietary, language and religious needs. Staff members work closely with embassies, consulates and other governmental entities to assist in the admission process.

Research done at the hospital is conducted by affiliated physicians and scientists, and also by therapists, nurses, the chaplain and residents as they advance their knowledge in subspecialty areas of rehabilitation medicine. The Brain Injury Research Center (BIRC) brings together world-renowned researchers to study the complicated facets of recovery from brain injury, leveraging resources from NIDRR and the National Institutes of Health to conduct research that predicts participation outcomes after TBI and leads to interventions that improve these outcomes. The Spinal Cord Injury and Disability Research Center works to improve functional recovery, health and quality of life for individuals with spinal cord injury (SCI) and other physical disabilities. The Center for Research on Women with Disabilities (CROWD) conducts research studies on health promotion and wellness, abuse, reproductive health, sexuality, independent living and access to health care for women with disabilities. The NeuroRecovery Research Center forms the umbrella for seven independent laboratories at TIRR Memorial Hermann that collaborate on basic science studies and clinical trials, using a holistic approach to study aspects of recovery for people with various neurological and physical disorders across the lifespan, and to identify new ways to improve function and quality of life.

The Independent Living Research Utilization (ILRU) program is a national center for information, training, research and

technical assistance in independent living. Established in 1977 and grounded in advocacy, the ILRU program works with independent living centers and other disability-focused organizations around the country to remove barriers to independence for people with disabilities.

Although the medical acuity of patients is much higher than in most rehabilitation facilities nationwide, TIRR Memorial Hermann consistently has significant, positive functional independence measure (FIM) change scores due to innovations in therapy and equipment. In addition to Restorative Therapies FES (functional electronic stimulator) cycles, Bioness® hand rehabilitation and foot drop systems, the VitalStim Experia™ clinical unit and IOPI Medical's Iowa Oral Performance Instrument, the hospital has a closed-loop body weight support system by Bioness, called the Vector Elite, in its main therapy gym. The Vector allows patients to walk continuously in the gym environment over more than 100 feet of track.

The hospital has acquired and trained staff with robotic exoskeleton devices for research and future clinical use – Ekso™ and ReWalk™, Armeo® and ReJoyce® are used for upper arm and shoulder recovery, along with upper-extremity FES cycles. In addition, the hospital's weekend therapy program and “seven meaningful days” philosophy has allowed teams to improve efficiency of care delivery, resulting in greater functional progress for patients.

The TIRR Memorial Hermann Rehabilitation Network extends expertise found at the Texas Medical Center across Houston and to The Woodlands, with a strong focus on restoring independence and helping people reintegrate into the community.

TIRR is a registered trademark of TIRR Foundation.

Neurotrauma and Neuroscience Critical Care

The Neurotrauma and Neuroscience Critical Care Program at the Memorial Hermann Mischer Neuroscience Institute is internationally recognized for the treatment of high-acuity brain and spinal cord injuries. Affiliated physicians manage more neurotrauma cases than any other center in the United States, with neurointensivists and experienced mid-level practitioners staffing the 32-bed Neuroscience and Neurotrauma ICU around the clock to provide ongoing intensive care to critically ill patients. The program continues to grow and now operates the largest and busiest Neuro ICU in the region and the second largest in the nation.

The Neurotrauma and Neuroscience Care Program is an international leader in research conducted on

innovative treatments following neurotrauma, including participation in several multicenter trials. Investigators at the Mischer Neuroscience Institute, UTHealth Medical School and TIRR Memorial Hermann are studying biomarkers for pain in spinal cord injury; cranioplasty outcome following decompressive craniectomy; adult stem cell therapy in severe traumatic brain injury (TBI) and acute stroke patients; the effects of erythropoietin on cerebrovascular dysfunction and anemia in TBI; neural and behavioral sequelae of blast-related TBI; the safety and pharmacokinetics of riluzole in patients with traumatic acute spinal cord injury; coagulation and outcome from acute neurologic injury using thrombelastography; perihematomal response to tissue injury and outcomes from intracerebral hemorrhage (ICH); inflammation and global cerebral edema after subarachnoid hemorrhage (SAH); and other basic science research and clinical trials. The Neuroscience and Neurotrauma Critical Care Program, led by Kiwon Lee, M.D., FACP, FAHA, FCCM, associate professor and vice chair of neurosurgery and neurology for critical care, utilizes the most advanced medical technologies and devices, including a multimodal monitoring system.

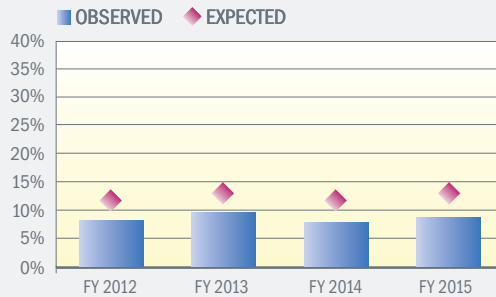
The Mischer Neuroscience Institute and UTHealth Medical School offer a two-year neurocritical care fellowship for applicants who are board certified or eligible in neurology, emergency medicine, anesthesia or internal medicine. A one-year fellowship track is open to eligible candidates who have completed postgraduate training in neurosurgery, medical critical care, anesthesia critical





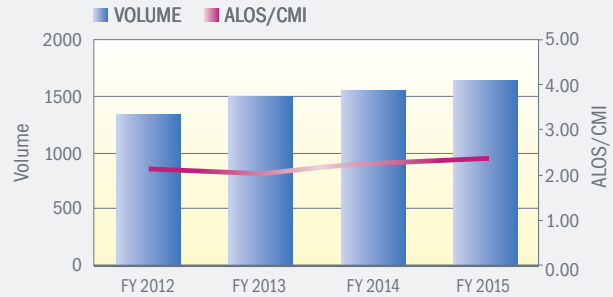
QUALITY & OUTCOMES MEASURES

Traumatic Brain Injury: Inpatient Mortality



Source: Chart data from the University HealthSystem Consortium

Traumatic Brain Injury: Volume & Length of Stay (CMI Adjusted)



Source: Chart data from the University HealthSystem Consortium

care or surgical critical care. The educational curriculum is specifically designed to train physicians with a strong base in general critical care, with an emphasis on neurological and neurosurgical emergencies. The Neuroscience ICU (NSICU) is equipped with multimodality monitoring capability including ICP, CPP, continuous video EEG monitoring, continuous cardiac output, S_{ij}O₂ monitoring and the country's first use of the latest model of digitalized brain oxymetry (PbtO₂) with monitors connected to patient bedside monitoring. The NSICU is a truly academic training environment where fellows work with neurosurgery, neurology, anesthesia and emergency medicine residents, as well as rotating fellows from other critical care programs. Fellows may rotate through the medical, surgical/trauma and cardiovascular ICUs and are offered a number of electives including anesthesiology, stroke, EEG, TCD, neuroradiology and burns. They also have the opportunity to work on the nation's first Mobile Stroke Unit.

The Mischer Neuroscience Institute was the first in Texas and the only center in the region to receive the highly coveted Comprehensive Stroke Center certification from The Joint Commission and the

American Heart Association/American Stroke Association. In addition to stroke, Neuro ICU team provides comprehensive high-level care for all neurological and neurosurgical vascular emergencies and illnesses. The dedicated ICU team operates in a closed-unit model and is the primary care team for surgical vascular patients, providing leading-edge care 24/7.

In March 2015, Mischer Neuroscience Institute sponsored the third annual Neuro ICU Symposium, a three-day course designed to educate physicians and other healthcare professionals on optimal management of patients using a team approach. The symposium emphasizes early treatment of neurotrauma patients, starting in the emergency room.

Patients with acute neurological injuries benefit from the Texas Trauma Institute at Memorial Hermann-Texas Medical Center – one of only two Level I trauma centers in the area and one of the busiest in the nation – and from Memorial Hermann Life Flight[®], the first air medical transport service established in Texas and the second in the nation. Built on the hospital's long-term collaboration with UTHealth

Medical School, the 200-bed Texas Trauma Institute provides high-quality care to both adult and pediatric trauma patients and offers a full spectrum of service including access to Houston's only verified burn center. Physicians affiliated with the Institute drive innovations in trauma care by moving research quickly from the laboratory to the bedside.

Patients at the Texas Trauma Institute also have access to additional services essential to trauma care: trauma and neuro critical care; trauma surgery; orthopedic surgery; emergency general surgery; emergency medicine; neurology and neurosurgery; oral maxillofacial, plastic and ENT surgery; hand surgery and plastic reconstructive surgery; transfusion medicine; physical medicine and rehabilitation; obstetrics and gynecology; urology; ophthalmology; heart and vascular; anesthesia; radiology; and hospitalists.

Memorial Hermann Life Flight, which is accredited by the Commission on Accreditation of Medical Transport Services, provides high-quality care and safe air transport for critically ill and injured patients. The Adult and Children's Transport Teams operate within a 300-mile radius of Houston using ground ambulance, a 150-mile radius using 24/7 air ambulance, and far beyond using private jet services. Memorial Hermann-TMC was the first hospital to give blood transfusions during transport.

RESEARCH HIGHLIGHT

A Mechanism for Global Cerebral Edema after Subarachnoid Hemorrhage: Pathophysiology of Early Brain Injury

PRINCIPAL INVESTIGATOR: **Huiman Alex Choi, M.D.**

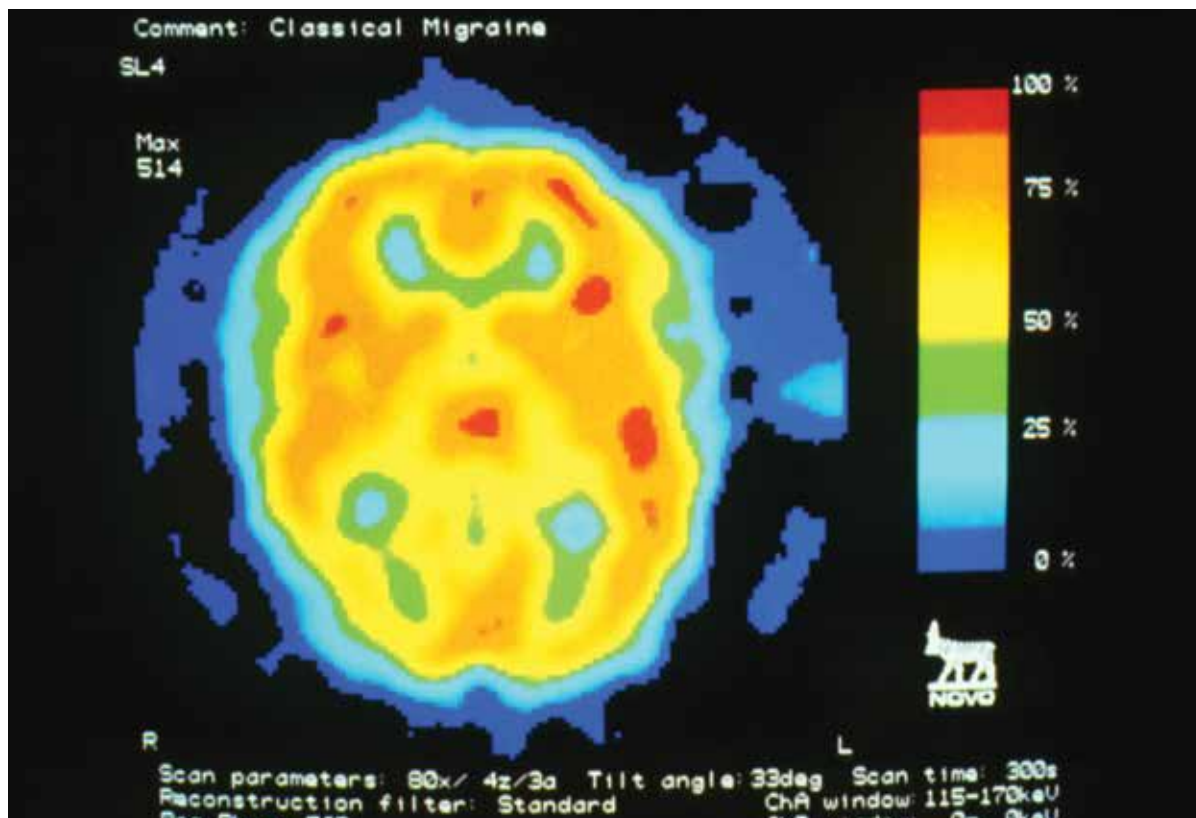
Assistant Professor, Vivian L. Smith Department of Neurosurgery, UTHealth Medical School

Researchers in Dr. Choi's lab are exploring the role of inflammatory serum and CSF biomarkers associated with global cerebral edema (GCE) after subarachnoid hemorrhage (SAH). GCE is a marker of early brain injury after subarachnoid hemorrhage and is associated with poor functional outcomes. Although some have speculated that GCE is an inflammatory process, very little is known about its pathomechanism. The investigators hypothesize that there is a difference in serum levels of pro- and anti-inflammatory cytokines in patients with and without GCE. Additionally, they believe the associations between cytokines are likely to be different in patients with and without GCE. They are using novel network exploratory techniques, data mining, and clustering and statistical techniques to find the underlying differences in inflammatory response in patients who develop GCE after SAH. The eventual goal is to understand the pathophysiology of GCE and develop targeted treatments to improve clinical outcomes.

Pain Management

Pain management is a critical part of the Institute's overall program. Specialists in interventional pain management and physical medicine and rehabilitation treat acute and chronic pain arising from trauma, nerve damage, degenerative conditions, cancer, and systemic metabolic disorders such as diabetes. The multidisciplinary team works in close collaboration to provide a variety of interventions and strategies for pain self-management to help people regain control of their lives.

The addition of Mark J. Burish, M.D., Ph.D., in 2015 added strength to the Pain Management Program at the Memorial Hermann Mischer Neuroscience Institute at the Texas Medical Center. A neurologist who is fellowship trained in interventional pain management, Dr. Burish directs the Will Erwin Headache Research Center at Memorial Hermann and UTHealth Medical School. Established with a \$20 million pledge from the Will Erwin Headache Research Foundation, the new Center includes a group of experts dedicated to the study of cluster headaches and other debilitating headaches and facial pain diseases.



CASE STUDY

Subcutaneous and Peripheral Nerve Stimulation for the Treatment of Horton's Neuralgia (Cluster Headaches) and Chronic Paroxysmal Hemicrania

Gunjan Silky Patel, M.D., Gaurav Sunny Sharma, M.D., Jonathan Kelling, M.D., and Frank Hsu, M.D.

A 71-year-old male presented with right-sided head pain involving his eye, temporal area and base of skull. Onset was 30 years earlier, occurring five times daily, lasting 30 minutes, and is described as a sensation of “nails piercing his head.” His past treatments included Botox[®] injections, endoscopic sinus surgery and septoplasty, none of which provided relief. Neurology diagnosed cluster headaches and chronic paroxysmal hemicrania (CPH) and started oxygen therapy and indomethacin. Although this helped, medication side effects were not tolerated. He then saw a pain management specialist and received right occipital nerve blocks with limited relief. He was referred to a neurosurgeon, who believed he had Horton's neuralgia, synonymous with cluster headaches, and that peripheral nerve stimulation (PNS) could be beneficial.

He underwent percutaneous placement of electrodes covering his areas of pain in the superior and inferior temporal areas extending toward his right eye and occipital region. During the pre-implantation trial, he reported 80 percent relief. Based on those results, he underwent permanent implantation of the leads with generator. He now has significant and lasting relief of his pain.

PNS is useful for treating pain that is not accessible by spinal cord stimulation. Our approach also involved subcutaneous peripheral nerve stimulation (SPNS), a variant of PNS, in which electrodes are positioned in the subcutaneous space subjacent to the region of pain. Thus, pain not restricted to a specific peripheral nerve distribution may be targeted. Trigeminal and occipital neuralgia are common disorders treated with cranial PNS. Alternatively, studies reporting the use of SPNS and PNS for Horton's neuralgia (cluster headaches) and CPH are rare. However, it should be considered in patients with Horton's neuralgia and CPH, as this case study demonstrates its efficacy.



Physicians and researchers working with the Will Erwin Headache Research Center include neurosurgeon Dong Kim, M.D.; researcher Georgene Hergenroeder, B.S.N., M.H.A., RN, CCRC; researcher Pramod Dash, Ph.D.; and genetic counselor Krista Qualmann, M.S. The group will work with other institutions across the country to develop a consortium of centers to identify patients with cluster headache and other debilitating types of headaches, with the goal of progressing in understanding and treating the disorders.

Dr. Patel and Dr. Dhanani are key members of the Pain Management Program. Dr. Patel is fellowship trained and double board certified in pain management and in physical medicine and rehabilitation. She joined the Mischer Neuroscience Institute in 2012 after completing her residency training in physical medicine and rehabilitation at Loyola University in Chicago, where she was co-chief resident, and a fellowship in pain medicine at Loma Linda University

in California. She specializes in interventional spine procedures, interventional musculoskeletal procedures and electrodiagnostic medicine. Board-certified anesthesiologist and interventional pain management specialist Nadya M. Dhanani, M.D., joined the Spine Center team in 2014 after completing her residency training in anesthesiology at Massachusetts General Hospital and a fellowship in pain medicine at The University of Texas MD Anderson Cancer Center. Dr. Dhanani's primary focus is spine and cancer-related pain. In addition to his headache research, Dr. Mark Burish treats patients with spine and neuropathic pain.

Disorders treated by the Institute's pain management specialists include cervical and lumbar radiculopathy and facet arthropathy; sacroiliac dysfunction; spinal stenosis; carpal tunnel syndrome; vertebral compression fractures; and neuropathic pain conditions, including peripheral neuropathy, diabetic neuropathy, post-herpetic neuralgia and central post-stroke pain. Treatment is highly individualized and may consist of kyphoplasty and vertebroplasty for vertebral compression fractures; stellate, celiac plexus, lumbar sympathetic, superior hypogastric, and ganglion impar blocks and neurolysis; facet injections, medial branch nerve blocks and radiofrequency ablation; sacroiliac joint blocks and strip lesioning using radiofrequency ablation; transforaminal, interlaminar and caudal epidural steroid injections; greater and lesser occipital, supraorbital and suprascapular nerve blocks; joint and muscle injections; and spinal cord stimulation.

Spine Disorders

The renowned spine surgeons affiliated with the Memorial Hermann Mischer Neuroscience Institute at the Texas Medical Center offer the most advanced treatments available today, both surgical and nonsurgical. They perform more than 2,000 procedures annually, making the spine program the largest in the region.

Nationally and internationally renowned neurosurgeon Daniel H. Kim, M.D., FACS, FAANS, has expanded the spinal neurosurgery program and added expertise in reconstructive peripheral nerve surgery, complex spinal reconstruction and minimally invasive spinal surgery, both endoscopic and robotic. A clinical and educational leader in his field, he has authored hundreds of papers and published 20 surgical textbooks, many of which are used at leading medical schools to teach standard-of-care techniques for neurosurgery. Dr. Kim is a pre-eminent researcher in peripheral nerve repair through nerve transfer and nerve graft, and is also recognized for his work in neurorehabilitation through robotics and cortical stimulation, spinal biomechanics and innovative neuromodulation treatments for chronic pain.

At the Spine Center a multidisciplinary team works in new, state-of-the-art facilities equipped with advanced instrumentation and dynamic imaging systems. They are skilled in minimally invasive spine procedures and innovative treatment options for patients with back pain resulting from trauma, degenerative disk disease, osteoporosis and related stress fractures, and deformity. Rehabilitation begins in the hospital following surgery.

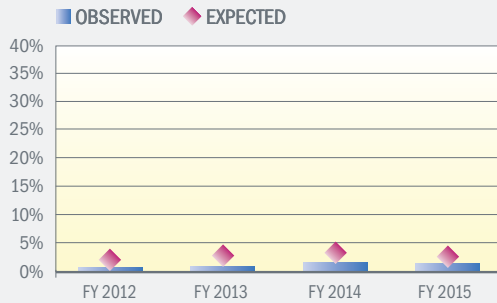
In 2015, Mischer Neuroscience Institute opened a state-of-the-art 16-bed Neuroscience Elective Unit with 10 beds dedicated to patients who choose to have spine surgery. Six beds are ICU level, reserved for patients admitted for brain surgery – for conditions such as trigeminal neuralgia, Chiari malformation, pineal cysts and brain tumors.

Pain management is a critical part of the Institute's spine program, and neurosurgeons work closely with specialists in physical medicine and rehabilitation and



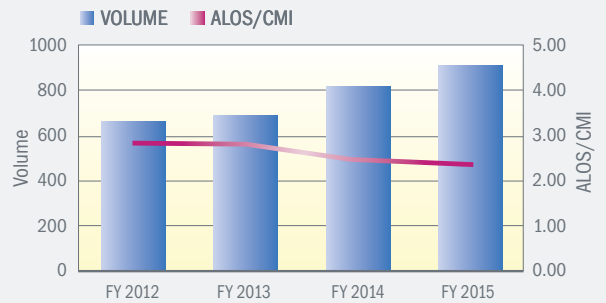
QUALITY & OUTCOMES MEASURES

Spine Degenerative or Elective: Inpatient Mortality



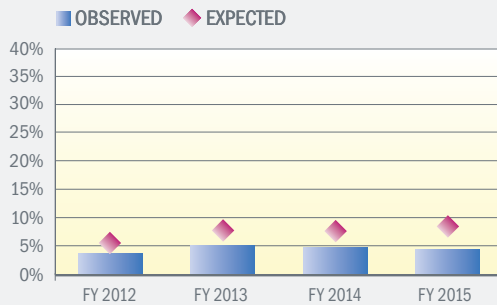
Source: Chart data from the University HealthSystem Consortium

Spine Degenerative or Elective: Volume & Length of Stay (CMI Adjusted)



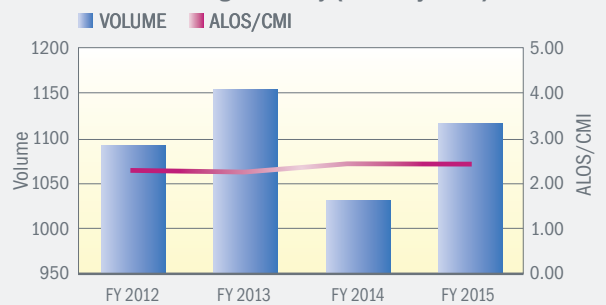
Source: Chart data from the University HealthSystem Consortium

Spine Trauma: Inpatient Mortality



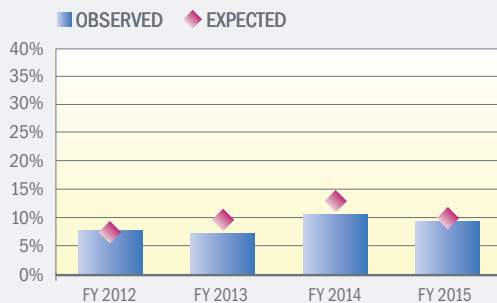
Source: Chart data from the University HealthSystem Consortium

Spine Trauma: Volume & Length of Stay (CMI Adjusted)



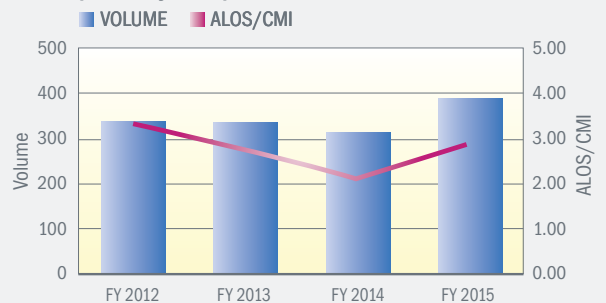
Source: Chart data from the University HealthSystem Consortium

Spine Tumors: Inpatient Mortality



Source: Chart data from the University HealthSystem Consortium

Spine Tumors: Volume & Length of Stay (CMI Adjusted)



Source: Chart data from the University HealthSystem Consortium

interventional pain management to help patients manage chronic back and neck pain. The multidisciplinary team works closely together to provide a variety of interventions and strategies for self-management to help people regain control of their lives. G. Silky Patel, M.D., who is fellowship trained in pain management and double board certified in pain management and physical medicine and rehabilitation, specializes in interventional spine procedures, interventional musculoskeletal procedures and electrodiagnostic medicine. Her primary focus is on interventional spine and musculoskeletal care, such as epidural injections, prescribing physical therapy and electrodiagnosis of nerve and muscle conditions that cause pain, numbness, tingling or weakness. Anesthesiologist and interventional pain management specialist Nadya M. Dhanani, M.D., joined the Spine Center team in 2014 after completing her fellowship in pain medicine at The University of Texas M. D. Anderson Cancer Center. Dr. Dhanani's primary focus is spine and cancer-related pain.

The Center's clinicians provide exceptional care for patients with traumatic spine injury, including the 10 to 20 percent of admissions through the Level I Texas Trauma Institute that involve neurological damage. Based on benchmark University HealthSystem Consortium data, the Spine Center's inpatient mortality for spine trauma, degenerative spine disease and elective spine surgery has been consistently lower than expected for the past eight years.

Physicians affiliated with the Mischer Neuroscience Institute are committed to providing exceptional clinical care with a strong focus on patient safety and the highest quality outcomes for patients. They specialize in artificial disk replacement, birth palsies, brachial

plexus injuries, carpal tunnel syndrome, congenital spine disorders, median nerve injuries, nerve sheath tumors, neurofibromatosis, neuromodulation for nerve injuries, neuromodulation for chronic headache, pelvic plexus injuries, peripheral nerve injuries, peroneal nerve injuries, pudendal nerve entrapment, piriformis syndrome, radial nerve injuries, sciatic nerve injuries, spinal AVMs, spinal stenosis, spine and spinal cord tumors, spine deformity, spine disk herniation, spine fractures, spine infection, tibial nerve injuries and ulnar nerve entrapment.

As faculty at UTHealth Medical School, surgeons at the Center educate the next generation of spine experts and shape the future of medicine through basic science research, clinical discovery and the development of new, breakthrough treatments. Research under way at the Spine Center is focused on bringing promising therapies for spinal cord injury (SCI) patients from the laboratory to clinical trials in a manner that will provide evidence of effectiveness, with maximum safety, to patients undergoing treatment. Investigation is currently focused on tissue engineering matrices and axon regeneration, gene transmission and regulation of stem cell differentiation, the safety of the anticonvulsant drug riluzole in patients with SCI, and novel neuroprotection therapeutic approaches to SCI, among other projects.

Research and Innovation





Physicians affiliated with the Memorial Hermann Mischer Neuroscience Institute and UTHealth Medical School are engaged in a broad and intensive research program focused on the mechanisms, treatment and cure of neurological disease and injury. They use diverse approaches – molecular, transgenic and electrophysiological techniques – in biomedical studies, translational research, clinical trials, and technology development and assessment.

Research is supported by the National Institutes of Health, the Vivian L. Smith Foundation for Neurologic Disease, the American Stroke Association and other granting agencies. Investigations cover major areas of neurological disease, including stroke, aneurysm, spinal cord injury, brain tumor, stem cell therapies, neuroprotection, hypoxic encephalopathy, epilepsy, traumatic brain injury and Parkinson's disease. During the 2014-2015 fiscal year, researchers at the Institute and UTHealth Medical School received more than \$10 million in 70 grants and contracts. The following listing is a sample of ongoing or recently completed research projects.

CEREBROVASCULAR

Advanced Artificial Extracellular Matrix for Treatment of Chronic Stroke

PRINCIPAL INVESTIGATOR: **Laura Smith Callahan, Ph.D.**

Investigators aim to develop a difunctionalized hyaluronic acid matrix containing optimized neuroigin and laminin concentration for axon extension and restoration of neurological function in rat models of stroke.

An Operator-blinded Study of the Efficacy of ShuntCheck-Micro-Pumper, a Noninvasive Diagnostic Procedure, in Detecting Ventricular Shunt Patency or Occlusion and in Predicting Clinical Outcome in Children and Adolescents Presenting to Emergency Departments and Neurosurgery Clinics

PRINCIPAL INVESTIGATOR: **David Sandberg, M.D.**

Researchers are investigating a device to determine the diagnostic accuracy (sensitivity and specificity) of the ShuntCheck-Micro-Pumper procedure in detecting

shunt patency or obstruction in symptomatic pediatric hydrocephalus patients, and will compare its accuracy to the accuracy of current diagnostic procedures (most typically CT scan).

Cerebral Protection in Transcatheter Aortic Valve Replacement

LEAD PHYSICIAN: **Richard Smalling, M.D., Ph.D.**

TAVR is associated with increased risk for silent cerebral embolism. The objective of the study is to assess the safety and efficacy of the Claret Medical Sentinel Cerebral Protection System used for embolic protection during transcatheter aortic valve replacement (TAVR) compared to TAVR standard of care (without embolic protection). A secondary endpoint of the investigation is to assess neurocognitive outcomes following TAVR.

Chromosomal and Hormonal Contributions to Sex Differences in Ischemic Stroke

LEAD PHYSICIAN: **Louise D. McCullough, M.D., Ph.D.**

There is considerable evidence from both clinical and experimental studies that outcomes after stroke differ in males and females. New experimental data has shown that brain cells die differently in the male versus the female brain, and each sex responds differently to neuroprotective strategies. As stroke is now the number one cause of disability, new treatments are urgently needed.

Effects of X Chromosome-linked Proteins on Sexual Dimorphism in Ischemic Stroke

PRINCIPAL INVESTIGATOR: **Fudong Liu, M.D.**

Clinically, ischemic stroke is recognized as a sexually dimorphic disease. There are hormone independent effects on ischemic sensitivity. At both neonatal and postmenopausal age, hormone levels are relatively equivalent between the sexes; tissue damage and functional outcomes must be influenced by biologic sex (XX vs. XY) in addition to the hormonal milieu. The researchers are utilizing neonatal and aged FCG mice to investigate ischemic outcomes when hormonal levels are equivalent between the sexes in this project.

Fetal Microchimeric Responses to Ischemic Stroke

LEAD PHYSICIAN: **Louise D. McCullough, M.D., Ph.D.**

Events that occur during pregnancy can have lasting implications on both the mother and fetus for decades after parturition. In particular, fetal microchimerism, the bidirectional exchange and persistence of cells between a pregnant female and her fetus, has been shown to play a role in various disease pathologies but has not been well studied in the brain. We hypothesize that



microchimeric cells (MCs) home to sites of injury as part of the immune response to stroke and display a stem cell phenotype with potential to aid in repair.

Immunomodulatory Effects of Inter-alpha inhibitors in Attenuating Ischemic Stroke

LEAD PHYSICIAN: **Louise D. McCullough, M.D., Ph.D.**

Stroke is the leading cause of long-term disability in the U.S. Unfortunately, current stroke therapies approved for human use are very limited. Preliminary work in our lab performed in collaboration with Dr. Yow-Pin Lim using exogenously administered blood-derived human IAIP has found that this agent is strikingly neuroprotective after experimental stroke, even when given six hours after ischemic onset to aged mice. We propose to further explore the potential neuroprotective efficacy of IAIP to determine if this is a viable therapeutic target to develop as a treatment for ischemic stroke.

IRF5-IRF4 Regulatory Axis: A New Target for Stroke

PRINCIPAL INVESTIGATOR: **Fudong Liu, M.D.**

Microglial activation is a key element in initiating and perpetuating innate immune responses to cerebral ischemia. Microglial responses are characterized as either M1, classical activation (pro-inflammatory), or M2, alternative activation (anti-inflammatory). We hypothesize that the IRF5-IRF4 regulatory axis balances the TLR4-MyD88-IRF5 and IL4R-Jmjd3-IRF4 pathways to direct microglial M1/M2 polarization after stroke, and that manipulation of the IRF5-IRF4 regulatory axis confers neuroprotection by suppressing/promoting pro-/anti-inflammatory responses, respectively. Manipulation of the IRF5-IRF4 regulatory axis in microglia/infiltrating leukocytes may help limit ischemic injury and promote tissue repair after stroke.

Nondisplaced Skull Fractures in Children: Is Hospital Admission Always Necessary?

LEAD PHYSICIAN: **David Sandberg, M.D.**

Investigators are identifying the instances under which hospital admission is a necessity for pediatric patients diagnosed with nondisplaced skull fractures.

Non-operative Management of Suspected Calvarial Langerhans Cell Histiocytosis

LEAD PHYSICIAN: **David Sandberg, M.D.**

Researchers in this prospective multicenter cohort trial are evaluating outcomes in children with probable isolated calvarial Langerhans cell histiocytosis.

Optimizing Patient Selection for Endovascular Treatment in Acute Ischemic Stroke (SELECT)

LEAD PHYSICIAN: **Amrou Sarraj, M.D.**

SELECT is a multicenter observational prospective study implementing a protocol to acquire imaging and clinical variables known to affect clinical outcomes after endovascular therapy. UTHealth Medical School is the hub center in this study, which includes eight U.S. centers.

Risk of Radiation-induced Malignancies from Computerized Tomography (CT) Scanning in Children Shunted Before 6 Years of Age

LEAD PHYSICIAN: **David Sandberg, M.D.**

In this multicenter trial, investigators are assessing the risk of radiation-induced malignancies from computerized tomography (CT) scanning in children CSF shunted before 6 years of age.

Role of MIF in Depression and Post-stroke Recovery

PRINCIPAL INVESTIGATOR: **Venugopal Reddy Venna, Ph.D.**

Clinical data suggests that older age and depression are risk factors for poor outcome in stroke patients, and the incidence of both stroke and depression increase with age. Aging is also associated with poor recovery and high mortality after stroke. We have found that macrophage migration inhibitory factor (MIF) levels decline with age, and mice with genetic deletion of MIF have a depressive phenotype at baseline, and have significantly impaired



functional recovery after stroke compared to wild-type mice. This proposal will determine the role of MIF in post-stroke recovery and the mechanism by which aging and depression interact to contribute to impaired stroke recovery.

The Neuroprotective Potential of TGF-beta Activated Kinase Inhibition in Acute Stroke

LEAD PHYSICIAN: **Louise D. McCullough, M.D., Ph.D.**

There is considerable evidence from both clinical and experimental studies that the outcomes after stroke differ in the aged. Experimental studies need to test promising therapies in a variety of animal models before attempting to move them into clinical trials. New data from the bench has identified a novel signaling pathway involved in the response to stroke (TAK-1) and we will test if inhibition of this pathway is protective in aging and explore potential mechanisms for its protective actions using cell specific knockout models.

The Park-Reeves Syringomyelia Research Consortium

LEAD PHYSICIAN: **Manish Shah, M.D.**

This multicenter research effort will create a disease registry of syringomyelia and Chiari I malformation to study these disorders, their natural history and their clinical course.

The Role of CaMK Cascade in Stroke

PRINCIPAL INVESTIGATOR: **Jun Li, Ph.D.**

Stroke is the third leading cause of death in the U.S. and the most common cause of disability. We have recently found that CaMK signaling is an important contributor to the protection induced by the brain during injury. In this application, we will pursue a focused investigation on the functional role of this signaling pathway in stroke in an attempt to develop novel treatments for stroke.



EPILEPSY

A Study of the Structure and Function of the Retina in Adult Patients with Refractory Complex Partial Seizures Treated with Vigabatrin (Sabril®)

LEAD PHYSICIAN: **Jeremy Slater, M.D.**

The purpose of the study is to evaluate the change in visual fields by means of automated static perimetry and to evaluate the change in retinal structure by means of spectral domain optical coherence tomography (SD-OCT) in adult patients with refractory complex partial seizures (CPS) being treated with vigabatrin.

Diffusion Tensor and Functional Connectivity Imaging in Pediatric Epilepsy: Imaging/Histology Correlation

LEAD PHYSICIAN: **Manish Shah, M.D.**

This study is determining if diffusion tensor and functional connectivity magnetic resonance imaging are helpful in better understanding and diagnosing intractable epilepsy in children.



Exploring Sparsity and Spectral-temporal Decomposition in Real-time Network Modulation for Intractable Epilepsy

LEAD PHYSICIAN: **Nitin Tandon, M.D.**

The researchers are developing algorithms to capture the dynamic, frequency-dependent connectivity of the brain from real-time monitoring of the brain using electrocorticography, identifying the optimal parameters for the low-frequency electrical stimulation to modulate the connectivity of the epilepsy network with temporal and spatial precision.

Noninvasive Measurement of Vigabatrin-induced Changes in Brain GABA Levels Utilizing Magnetic Resonance Spectroscopy (MRS)

LEAD PHYSICIAN: **Jeremy Slater, M.D.**

The GABA-MRS trial is an attempt to use magnetic resonance spectroscopy to measure levels of different neurotransmitters in the brain before and after starting

an anti-epileptic drug. The drug under study is vigabatrin (Sabril®), chosen because it blocks the breakdown of gamma-Aminobutyric acid (GABA) in the brain and, as a result, should trigger extremely high levels. Researchers know that too much excitation or too little inhibition can contribute to seizures in the brains of patients suffering from epilepsy. This study looks at levels of the inhibitory neurotransmitter GABA, the excitatory neurotransmitter glutamate and several others. Patients will have a baseline study; the study is repeated 6 hours after their first dose of the new drug, and then again after they have been taking the medication for 6 weeks.

VNS Therapy Automatic Magnet Mode Outcomes Study in Epilepsy Patients Exhibiting Ictal Tachycardia

LEAD PHYSICIAN: **Jeremy Slater, M.D.**

Researchers in this multicenter trial are obtaining baseline clinical outcome data (stage 1) upon which to base a subsequent study (stage 2) of the Model 106 VNS implantable pulse generator.

MOVEMENT DISORDERS AND NEURODEGENERATIVE DISEASES

Cortical Plasticity in Spastic Diplegia after Selective Dorsal Rhizotomy

LEAD PHYSICIAN: **Manish Shah, M.D.**

In this study researchers are characterizing cortical connectivity changes in the brains of children with diplegic spasticity after selective dorsal rhizotomy.

Plasma Exchange to Treat Alzheimer's Disease

PRINCIPAL INVESTIGATOR: **Paul Schulz, M.D.**

This study tests the hypothesis that plasma exchange (PE) will improve the outcome for patients with

Alzheimer's disease. The researchers are translating to humans the results of mouse studies by Claudio Soto, Ph.D., in which PE was shown to reduce amyloid deposition and improve memory to normal level.

Stem Cells to Treat Parkinson's Disease

PRINCIPAL INVESTIGATOR: **Paul Schulz, M.D.**

Researchers are using a mouse model to investigate the type of stem cells and optimal conditions under which to raise them to improve the symptoms of Parkinson's disease, with the ultimate goal of translating study results through a human trial.

The Synergistic Roles of TBI and PTSD in Producing Cognitive Impairment

PRINCIPAL INVESTIGATOR: **Paul Schulz, M.D.**

The investigators are studying the roles of traumatic brain injury and posttraumatic stress disorder in producing early and late cognitive impairment.

MULTIPLE SCLEROSIS

Application Development for Patients with MS Exacerbations: Phase II Symptom Diary

LEAD PHYSICIAN: **Flavia Nelson, M.D.**

With an MS Entrepreneurs Grant from the National Multiple Sclerosis Society, the investigators created an MS Attack application currently in use by many patients who visit the MS clinic. The app is designed to help patients understand what an MS exacerbation is, when to report it and the importance of early reporting. Dr. Nelson and her team are collecting data that will reflect the number of exacerbations captured by the app, which is free and available for Android and Apple.

Detection of MS-related Cognitive Impairment: In Search of MRI Surrogate Markers

LEAD PHYSICIAN: **Flavia Nelson, M.D.**

The major aim of this study is to develop and apply a multimodal MRI approach to the evaluation of cognitive impairment in patients with multiple sclerosis.

Protocol 101MS408

LEAD PHYSICIAN: **Flavia Nelson, M.D.**

This multicenter, randomized, open-label study is assessing the impact of natalizumab versus fingolimod on central nervous system tissue damage and recovery in active relapsing-remitting multiple sclerosis subjects.

Protocol EFC6260

LEAD PHYSICIAN: **Jerry Wolinsky, M.D.**

This international, multicenter, randomized, double-blind, placebo-controlled, parallel group study is evaluating the efficacy and safety of two-year treatment with teriflunomide, 7 milligrams once daily and 14 milligrams once daily versus placebo in patients with a first clinical episode suggestive of multiple sclerosis.

Protocol HSC-MS-12-0798

LEAD PHYSICIAN: **Flavia Nelson, M.D.**

This phase IV randomized, double-blind, multicenter, parallel-group study compares the efficacy and safety of fty-720 0.5 mg administered orally once daily versus 0.25 mg versus glatiramer acetate in patients with relapsing-remitting multiple sclerosis.

NEUROMUSCULAR DISORDERS

International Guillain-Barré Syndrome (GBS)

Outcome Study

LEAD PHYSICIAN: **Kazim Sheikh, M.D.**

This international multicenter clinical outcome trial on patients with Guillain-Barré syndrome (GBS) is enrolling patients through 2017. The study, which does not include intervention and will not interfere or change the treatment regimen or patient management, aims to identify clinical and biological determinants of disease progression and recovery in GBS.

NEURO-ONCOLOGY

Autopsy, Identification of Molecular Abnormalities in Postmortem Glioblastoma Specimens Treated with Bevacizumab

LEAD PHYSICIAN: **Jay-Jiguang Zhu, M.D., Ph.D.**

The researchers are collecting brain tissue and tissue from other organs postmortem to learn more about the correlation of imaging changes on MRI to GBM tumor progression versus radiation-related necrosis. They expect to find molecular abnormalities in the areas showing changes on MRI that may not be revealed during traditional pathological studies. In the process, they hope to learn more about tumor progression and organ toxicity associated with the long-term use of temozolomide and/or bevacizumab.

Correlations of Prenatal Findings of Fetal Hydrocephalus with the Need for Surgical Intervention at Birth

LEAD PHYSICIAN: **David Sandberg, M.D.**

The findings provide information for physicians and parents regarding the likelihood of surgical intervention and timing in children diagnosed with hydrocephalus in utero.

Cortice 17, NCT01933815

LEAD PHYSICIAN: **Sigmund Hsu, M.D.**

This Phase 1/2 dose-escalation study of TPI 287 examines its efficacy in combination with bevacizumab followed by randomized study of the maximum tolerated dose of TPI 287 in combination with bevacizumab versus bevacizumab alone in adults with recurrent glioblastoma.

Cortice 18, NCT02047214

LEAD PHYSICIAN: **Sigmund Hsu, M.D.**

Researchers are conducting this Phase 2 dose-escalation study of TPI 287 in combination with bevacizumab in adults who have recurrent or progressive glioblastoma following a bevacizumab containing regimen.

DCVax-L

LEAD PHYSICIAN: **Jay-Jiguang Zhu, M.D., Ph.D.**

This phase 3 clinical trial is evaluating DCVax[®]-L, autologous dendritic cells pulsed with tumor lysate antigen, for the treatment of glioblastoma multiforme.

Diffusion, NCT01465347

LEAD PHYSICIAN: **Jay-Jiguang Zhu, M.D., Ph.D.**

In this open-label Phase 1/2 safety lead-in study, the safety and efficacy of trans sodium crocetinate with concomitant treatment of fractionated radiation therapy and temozolomide are being evaluated in newly diagnosed glioblastoma patients.

DTI 022

LEAD PHYSICIAN: **Jay-Jiguang Zhu, M.D., Ph.D.**

This is a Phase 2 trial of the safety and tolerance of intravenous 4-demethoxy-4-cholesteryloxy carbonyl penicillamine (DM-CHOC-PEN) in patients with malignancies involving the central nervous system.

Foundation One, NCT01851213

LEAD PHYSICIAN: **Sigmund Hsu, M.D.**

In this prospective observational study, researchers are examining routine clinical practice patterns and the impact on clinical decision-making associated with the FoundationOne™ Next Generation Sequencing Test.

ICT-107 Brain Tumor Vaccine for Patients with Newly Diagnosed Glioblastomas

LEAD PHYSICIAN: **Jay-Jiguang Zhu, M.D., Ph.D.**

Investigators in this randomized, double-blind Phase 2B multicenter trial are assessing the safety and efficacy of the ICT-107 vaccine in newly diagnosed patients with glioblastoma multiforme (GBM) following tumor resection. ICT-107 is an immunotherapy in which the patient's immune response will be stimulated to kill the tumor cells. Some of the patient's white blood cells (WBC) will be removed and cultured in a laboratory with purified antigens, similar to those on GBM cells. The patient's own WBC/dendritic cells that have been exposed to the tumor antigens will then be given back to the patient as a vaccine over several months. Researchers are investigating whether the ICT-107 vaccine will stimulate the patient's immune response to kill the remaining GBM tumor cells after surgery and chemotherapy.



Methotrexate Infusion into the Fourth Ventricle in Children with Recurrent Malignant Fourth Ventricular Brain Tumors: A Pilot Clinical Trial

LEAD PHYSICIAN: **David Sandberg, M.D.**

Under an IRB-approved protocol, for the first time in humans, methotrexate was infused into the fourth ventricle in patients with recurrent malignant fourth ventricular tumors. Preliminary results of this study are extremely promising, as no patients suffered any new neurological problems and all patients with medulloblastoma responded to the treatment.

NCI 2015

LEAD PHYSICIAN: **Jay-Jiguang Zhu, M.D., Ph.D.**

This phase 2/3 randomized trial is evaluating the efficacy of veliparib or placebo in combination with adjuvant temozolomide in newly diagnosed glioblastoma with MGMT promoter hypermethylation.



NovoCure EF-14, NCT00916409

LEAD PHYSICIAN: **Jay-Jiguang Zhu, M.D., Ph.D.**

In this prospective multicenter trial, researchers are examining the efficacy of the NovoTF-100A device together with temozolomide in newly diagnosed glioblastoma multiforme patients, compared to treatment with temozolomide alone.

Phase I Study of Methotrexate Infusion into the Fourth Ventricle in Children with Recurrent Malignant Fourth Ventricular Brain Tumors

LEAD PHYSICIAN: **David Sandberg, M.D.**

This is a Phase I dose-escalation trial with the direct administration of methotrexate into the fourth ventricle of the brain for the treatment of children with recurrent malignant fourth ventricular brain tumors.

NEUROREHABILITATION

Mapping Human Memory with Electrocorticography and Chronometric Stimulation

LEAD PHYSICIAN: **Nitin Tandon, M.D.**

The researchers employ innovative recordings (ECoG) during human episodic memory and then perturb areas of high connectivity using chronometric stimulation. This work will provide insight into the extent to which other brain regions can compensate for lost function following stroke-related lesions to the medial temporal lobes, and advance understanding of potential ways to design and implement deep brain stimulators to treat cognitive impairments accompanying neural disease.

Micro-scale Real-time Decoding and Closed-loop Modulation of Human Language

LEAD PHYSICIAN: **Nitin Tandon, M.D.**

Investigators are developing an unparalleled understanding of cortical connectivity in the human language system at small spatio-temporal scales. Intracranial recording and cortical stimulation to modulate the language system during speech production are being used. This integrative project uses data obtained in this way to design innovative biocompatible microchips that can record neural signals, digitize them and transmit the signals to an in vitro receiver wirelessly.

Pain Management for Horton's Neuralgia (Cluster Headaches) and Chronic Paroxysmal Hemicrania

LEAD PHYSICIAN: **G. Silky Patel, M.D.**

This case study demonstrates the efficacy of subcutaneous and peripheral nerve stimulation for the treatment of cluster headaches and chronic paroxysmal hemicranias.

NEUROTRAUMA/CRITICAL CARE

A Mechanism for Global Cerebral Edema After Subarachnoid Hemorrhage: Pathophysiology of Early Brain Injury

LEAD PHYSICIAN: **H. Alex Choi, M.D.**

Early brain injury after subarachnoid hemorrhage is the most important determinant of outcome. Using cerebrospinal fluid and serum markers of inflammation, the researchers are exploring the mechanisms of early brain injury and global cerebral edema after subarachnoid hemorrhage.

Application of Machine-learning Techniques to Improve Outcomes After Aneurysmal Subarachnoid Hemorrhage

LEAD PHYSICIAN: **H. Alex Choi, M.D.**

Around 20 to 30 percent of aSAH patients develop secondary complications during the course of a hospital stay. Complications include delayed cerebral ischemia, sepsis and SIRS, and are invariably associated with poor outcomes. By using retrospective data and prospective long-term outcome information of aSAH patients, admitted at Memorial Hermann-Texas Medical Center, the researchers are using computer algorithms to develop clinically useful decision-support systems. Predicting and treating complications after SAH before they occur will reduce the morbidity and improve functional outcomes in aSAH patients.

Disruption of Cerebral Autoregulation After Acute Brain Injury

LEAD PHYSICIAN: **H. Alex Choi, M.D.**

The researchers are investigating the disruption of the cerebral autoregulation mechanism in patients with acute brain injury and its effects on outcomes. Since the brain is very sensitive to over- and under-perfusion, any disruption in this mechanism can result in poor clinical outcomes. By analyzing retrospectively collected patient data such as intra-cranial pressure (ICP) and arterial blood pressure, the investigators seek to quantify the extent to which the mechanism is compromised and determine its association with clinical outcomes.

Hypothermia for Patients Requiring Evacuation of Subdural Hematoma: A Multicenter Randomized Clinical Trial (HOPES)

LEAD PHYSICIAN: **Dong Kim, M.D.**

This randomized, prospective trial will study the effect of very early cooling in patients undergoing surgical

evacuation of acute subdural hematomas (35°C prior to opening the dura followed by maintenance at 33°C for a minimum of 48 hours). Intravascular cooling catheters (Thermogard XP Device, Zoll) will be utilized to induce hypothermia or to maintain normothermia. The primary objective is to determine if rapid induction of hypothermia prior to emergent craniotomy for traumatic subdural hematoma will improve outcome as measured by Glasgow Outcome Scale-Extended (GOSE) at 6 months.

Perihematoma Response to Tissue Injury and Clinical Outcome (PORTICO)

LEAD PHYSICIAN: **Nancy J. Edwards, M.D.**

PORTICO is an observational study in acute intracranial hemorrhage patients treated at Memorial Hermann-Texas Medical Center. The goal is to identify biomarkers of inflammation and hemoglobin degradation that correlate with clinical and radiologic outcomes, including long-term outcomes. The researchers are examining serial biomarkers in serum and cerebrospinal fluid in conjunction with cross-sectional data from perihematomal neuronal tissue obtained during hematoma evacuation.

Predicting Clinical Outcomes: Prognosis (PRECOG)

LEAD PHYSICIAN: **H. Alex Choi, M.D.**

A collaborative project between nurses and physicians, this prospective observational study examines the accuracy of clinician prognostication in patients with subarachnoid hemorrhage (SAH) admitted to the Neuroscience Intensive Care Unit at Memorial Hermann-Texas Medical Center. Nurses, neurointensive care fellows and neurointensivist attending physicians who were directly involved in the patient's care will be asked about their best prognosis for SAH patients. Patients will be followed in clinic to determine the accuracy of the clinicians' prognosis.

SPINE

Identification of Novel Regulatory Mechanisms and Therapeutic Targets for Treating Spinal Cord Injury

PRINCIPAL INVESTIGATOR: **Jiaqian Wu, Ph.D.**

New regulatory mechanisms and molecular targets for spinal cord injury are being identified using gene transcription profiling, computational analysis and functional assays. The researchers have identified a new class of potential therapeutic targets – long noncoding RNAs – in oligodendrocyte precursor formation from neural stem cells. RNA-based therapeutics represent promising new strategies for treating neurological disorders.

Optimization of Tissue Engineering Matrices for SCI Treatment

PRINCIPAL INVESTIGATOR: **Laura Smith Callahan, Ph.D.**

The study aims to determine the optimal Young's Modulus and concentration of laminin (IKVAV) and n-cadherin (HAVDI) peptides on maturation of human induced pluripotent stem cell derived neural stem cells toward mature neurons in 2-D culture on continuous gradient polyethylene glycol hydrogels.

OTHER

A Microsurgical Robotic System

PRINCIPAL INVESTIGATORS: **Daniel H. Kim, M.D., Mark Dannenbaum, M.D., and Dongsuk Shin, Ph.D.**

In this study, researchers are developing a surgical robotic system capable of performing microsurgery in the brain.

A Steerable Robotic Microcatheter Using an Electroactive Polymer

PRINCIPAL INVESTIGATORS: **Daniel Kim, M.D., Mark Dannenbaum, M.D., Dongsuk Shin, Ph.D., and Viljar Palmre, Ph.D.**

The researchers are developing a steerable robotic catheter system capable of navigating narrow blood vessels in the brain. The ElectroActive Polymer (EAP)-based catheter system represents a new tool for catheter-based cerebral intervention with the potential to improve the treatment of cerebral vascular disease.

A Robot-Assisted, Image-Guided Surgery System

PRINCIPAL INVESTIGATORS: **Daniel H. Kim, M.D., Mark Dannenbaum, M.D., Dongsuk Shin, Ph.D., and Taeho Jang, Ph.D.**

The investigators are developing a robot-assisted, image-guided surgery system using a novel registration method, which includes a patient-specific registration guide. The patient-specific guide for registration is built based on the patient's CT data, using a 3-D printer prior to surgery.

Deep Brain Stimulation (DBS) Therapy for Treatment Resistant Depression

PRINCIPAL INVESTIGATOR: **Jair C. Soares, M.D., Ph.D.**

This clinical pilot study is investigating medial forebrain bundle (MFB) deep brain stimulation (DBS) as a treatment in 10 patients with treatment refractory depression (TRD), using the Activa® system. The pilot study will obtain a preliminary indication of the feasibility, safety and efficacy of supero-lateral branch of the medial forebrain bundle (sIMFB)-DBS as a treatment for TRD. Individual patient response will be measured by standardized patient and clinician ratings of depression severity.



GCC/Keck Center's NLM Training Program in Biomedical Informatics

LEAD PHYSICIAN: **Nitin Tandon, M.D.**

This study is designed to enable production of an atlas of normative human electrophysiology from a cohort of individuals.

Intracranial Electrophysiology and Connectivity of Language Regions in Humans

LEAD PHYSICIAN: **Nitin Tandon, M.D.**

This study is designed to make accurate intermodal comparisons of intracranial EEG, fMRI, DTI tractography and electrical cortical stimulation mapping.

Selected Publications

BARRETO, ANDREW

Chaisinanunkul N, Adeoye O, Lewis RJ, Grotta JC, Broderick J, Jovin TG, Nogueira RG, Elm JJ, Graves T, Berry S, Lees KR, Barreto AD, Saver JL; DAWN Trial and MOST Trial Steering Committees; Additional contributors from DAWN Trial Steering Committee. Adopting a Patient-Centered Approach to Primary Outcome Analysis of Acute Stroke Trials Using a Utility-Weighted Modified Rankin Scale. *Stroke*. 2015 Aug;46(8):2238-43.

Rahbar MH, Dickerson AS, Cai C, Pedroza C, Hessabi M, Shen L, Pandurengan R, Jacobs AN, Indupuru H, Sline MR, Delgado RI, Macdonald C, Ford GA, Grotta JC, Barreto AD. Methodological issues for designing and conducting a multicenter, international clinical trial in Acute Stroke: Experience from ARTSS-2 trial. *Contemporary Clinical Trials*. 2015 Aug 13; pii: S1551-7144(15)30066-5.

Schellinger PD, Alexandrov AV, Barreto AD, Demchuk AM, Tsivgoulis G, Kohrmann M, Alleman J, Howard V, Howard G, Alexandrov AW, Brandt G, Molina CA; CLOTBUSTER Investigators. Combined lysis of thrombus with

ultrasound and systemic tissue plasminogen activator for emergent revascularization in acute ischemic stroke (CLOTBUST-ER): Design and methodology of a multinational phase 3 trial. *International Journal of Stroke*. 2015 Oct;10(7):1141-8.

Wu TC, Sarraj A, Jacobs A, Shen L, Indupuru H, Biscamp D, Ho V, Ankrom C, Grotta J, Savitz S, Barreto AD. Telemedicine-Guided Remote Enrollment of Patients into an Acute Stroke Trial. *Annals of Clinical and Translational Neurology*. 2015 Jan;2(1):38-42.

CHEN, PENG R.

Bulsara KR, Günel M, Amin-Hanjani S, Chen PR, Connolly ES, Friedlander RM. Results of a national cerebrovascular neurosurgery survey on the management of cerebral vasospasm/delayed cerebral ischemia. *Journal of NeuroInterventional Surgery*. 2015 Jun;7(6):408-11.

Hollingworth M, Chen PR, Goddard AJ, Coulthard A, Söderman M, Bulsara KR. Results of an International Survey on the Investigation and Endovascular Management of Cerebral Vasospasm

and Delayed Cerebral Ischemia. *World Neurosurgery*. 2015 Jun;83(6):1120-1126.e1. [Epub 2015 Feb 12]

Linfante I, Walker GR, Castonguay AC, Dabus G, Starosciak AK, Yoo AJ, Abou-Chebl A, Britz GW, Marden FA, Alvarez A, Gupta R, Sun CH, Martin C, Holloway WE, Mueller-Kronast N, English JD, Malisch TW, Bozorgchami H, Xavier A, Rai AT, Froehler MT, Badruddin A, Nguyen TN, Taqi MA, Abraham MG, Janardhan V, Shaltoni H, Novakovic R, Chen PR, Kaushal R, Nanda A, Issa MA, Nogueira RG, Zaidat OO. Predictors of Mortality in Acute Ischemic Stroke Intervention: Analysis of the North American Solitaire Acute Stroke Registry. *Stroke*. 2015 Aug;46(8):2305-8.

Turkmani AH, Edwards NJ, Chen PR. The role of inflammation in cerebral aneurysms. *Neurology: Neuroimmunology and Neuroinflammation*. 2015 Apr;2:102-6.

Turkmani AH, Day AL, Kim DH, Chen PR. Microsurgical clip reconstruction techniques for aneurysms with significant calcified neck. *Neurosurgical Focus*. 2015 Jul;39 Video Suppl 1:V12.





CHOI, H. ALEX

Choi HA, Fernandez A, Jeon SB, Schmidt JM, Connolly ES, Mayer SA, Claassen J, Badjatia N, Prager KM, Lee K. Ethnic disparities in end-of-life-care after subarachnoid hemorrhage. *Neurocritical Care*. 2015. June;22(3):423-8.

Choi HA, Samuel S, Allison TA. Paroxysmal Sympathetic Hyperactivity after Acute Brain Injury. In: Louis ED ed. *Merritt's Neurology 13th Edition*.

Gilmore EJ, Gaspard N, Choi HA, Cohen E, Burkart KM, Chong DH, Claassen J, Hirsch LJ. Acute brain failure in severe sepsis: a prospective study in the medical intensive care unit utilizing continuous EEG

monitoring. *Intensive Care Medicine*. 2015 April;41(4):686-94.

Jeon SB, Koh Y, Choi HA, Lee K. Critical care for patients with massive ischemic stroke. *Journal of Stroke*. 2014 Sep;16(3):146-60.

Karamchandani RR, Vahidy F, Bajgur S, Vu KY, Choi HA, Hamilton RK, Rahbar MH, Savitz SI. Early depression screening is feasible in hospitalized stroke patients. *PLOS One*. 2015 Jun 3;10(6):e0128246.

Ko SB, Choi HA, Helbok R, Schmidt JM, Badjatia N, Claassen J, Connolly ES, Mayer SA, Lee K. Quantitative analysis of hemorrhage clearance and delayed cerebral ischemia

after subarachnoid hemorrhage. *Journal of NeuroInterventional Surgery*. 2015 Aug 14;doi: 10.1136/neurintsurg-2015-011903. [Epub ahead of print]

Lee JS, Kang CH, Park SQ, Choi HA, Sim KB. Clinical significance of cerebral microbleeds locations in CADASIL with R544C NOTCH3 mutation. *PLOS One*. Feb 18;10(2):e0118163.

Lee K, Choi HA, Edwards N, Chang T, Sladen RN. Perioperative critical care management for patients with aneurysmal subarachnoid hemorrhage. *Korean Journal of Anesthesiology*. 2014 Aug;67(2):77-84.

Lord AS, Gilmore E, Choi HA, Mayer SA. Time course and predictors of neurological deterioration after intracerebral hemorrhage. *Stroke*. 2015 Mar;46(3):647-52.

Samuel S, Iluonakhamhe EK, Adair E, Macdonald N, Lee K, Allison TA, Choi HA. High dose subcutaneous unfractionated heparin for prevention of venous thromboembolism in overweight neurocritical care patients. *Journal of Thrombosis and Thrombolysis*. 2015 March;40:302-7.

Sim KB, Park SQ, Choi HA, Kim DH. Demonstration of traumatic subarachnoid hemorrhage from the

anterior choroidal artery. *Journal of the Korean Neurosurgical Society*. 2014. Dec;56(6):531-3.

DAY, ARTHUR

Day AL, Wang H. Posterior Communicating Artery Aneurysm Clipping. In: Berta SC, Levy ML (ed.): *Neurosurgery: Tricks of the Trade*. New York, Thieme Medical Publishers, 2014.

Day AL, Frank T, Esquenazi Levy Y. Basal Cistern Anatomy. In: *Atlas of Neurosurgical Techniques: Brain*, 2nd Edition. New York, Thieme Medical Publishers, 2014.

Day AL, Dannenbaum M, Jung S. A Randomized Trial of Unruptured Brain Arteriovenous Malformations Trial: An Editorial Review. *Stroke*. 2014 Aug 19. pii: STROKEAHA.114.004614.

Day AL, Turkmani AH, Yapticilar B. Surgical Therapies for Carotid-Ophthalmic Aneurysms (Chapter 46). In: *Neurovascular Surgery, 2e* by Drs Spetzler, Kalani, and Nakaji. New York, Thieme Medical Publishers, 2015.

Dunn IF, Day AL. Transcranial and Skull Base Surgical Approaches to the Sellar and Parasellar Region. In: *Atlas of Sellar and Parasellar Lesions: Clinical, Radiologic, and Pathologic Complications*, by Drs. Zada, Lopes, Mukundan Jr, and Laws Jr. Switzerland, Springer International Publishers, 2015.

Ho A, Lin N, Charoenvimolphan N, Stanley M, Frerichs KU, Day AL, Du R. Morphological parameters associated with ruptured posterior communicating aneurysms. *PLOS One*. 2014 Apr 14;9(4):e94837.

Morris SA, Jones W, Proctor M, Day AL. Emergent Treatment of Athletes With Brain Injury. *Neurosurgery: Current Concepts in Sports Concussions Supplement*. 2014 Oct;75:S96-S105.

Petraglia A, Bailes JE, Day AL (eds.): *Handbook of Neurological Sports Medicine*. Human Kinetics, 2014.

Turkmani A, Day AL, Kim DH, Chen PR. Microsurgical Clip Reconstruction Techniques for Aneurysms with Significant Calcified Neck. *Neurosurgical Focus*. 2015 July; 39 Video Suppl 1:V12.

EDWARDS, NANCY

Edwards NJ, Lee K. 2015. Endocrine disorders in neurocritical care. In: Hemphill JC, Rabinstein AA, Samuels OB, eds. *The Practice of Neurocritical Care*. Neurocritical Care Society. p. 454-66.

Edwards NJ, Almaghrabi TS, Lee K. 2015. Lumbar puncture and cerebrospinal fluid analysis. In: Louis ED, Mayer SA, Rowland LP, eds. *Merritt's Neurology*. 13th ed. Philadelphia (PA): Lippincott Williams & Wilkins. p. 246-50.

Turkmani AH, Edwards NJ, Chen PR. The role of inflammation in cerebral aneurysms. *Neurology: Neuroimmunology and Neuroinflammation*. 2015 Apr;2:102-6.

Zhao X, Wang H, Guanghua S, Zhang J, Edwards NJ, Aronowski J. Neuronal interleukin-4 as a modulator of microglial pathways and ischemic brain damage. *Journal of Neuroscience*. 2015 Aug;35(32):11281-91.

Zhao X, Guanghua S, Ting SM, Song S, Edwards NJ, Aronowski J. Cleaning up after ICH: the role of Nrf2 in modulating microglia function and hematoma clearance. *Journal of Neurochemistry*. 2015 Apr;133(1):144-52.

FLETCHER, STEPHEN

Arrey EN, Kerr ML, Fletcher S, Cox CS Jr, Sandberg DI. Linear nondisplaced skull fractures in children: who should be observed or admitted? *Journal of Neurosurgery: Pediatrics*. 2015 Sep 4:1-6. [Epub ahead of print] PMID: 26339955.

Papanna R, Moise KJ Jr, Mann LK, Fletcher S, Schniederjan R, Bhattacharjee MB, Stewart RJ, Kaur S, Prabhu SP, Tseng SC. Cryopreserved human umbilical cord patch for in-utero spina bifida repair. *Ultrasound in Obstetrics and Gynecology*. 2015 Oct 22. doi: 10.1002/uog.15790. [Epub ahead of print]

FURR-STIMMING, ERIN

Chiou-Tan F, Furr-Stimming E, John J, Harrell JS, Zhang H, and Taber KH. Procedure-Oriented Sectional Anatomy of the Foot. *Journal of Computer Assisted Tomography*. 2015 Jan-Feb;39(1):140-2.

Chiou-Tan F, Cianca J, Pandit S, John J, Furr-Stimming E, Taber KH. Procedure-oriented torsional anatomy of the proximal arm for spasticity injection. *Journal of Computer Assisted Tomography*. 2015 May-Jun;39(3):449-52.

Furr-Stimming E, Boyle A, Schiess MC. Spasticity Management and Intrathecal Baclofen. In: *Seminars in Neurology: Neurorehabilitation*, Eds. Gary Abrams and Karunesh Ganguly, Thieme Publishers. 2014;34:591-96.

Riecke J, Johns K, Cai C, Vahidy F, Parsha K, Furr-Stimming, Schiess M, Savitz Sean. A Meta-Analysis of Mesenchymal Stem Cells in Animal Models of Parkinson's Disease. *Stem Cells and Development*. 2015 Sept 15;24(18):2082-90.

Moruno Manchon JF, Uzor NE, Dabaghian Y, Furr-Stimming EE, Finkbeiner S, Tsvetkov AS. Cytoplasmic sphingosine-1-phosphate pathway modulates neuronal autophagy. *Scientific Reports*. 2015 Oct 19;5:15213.

Suescun J, Furr Stimming E, Patel N. Chapter in: *Dystonia and Deep Brain Stimulation*. Nova Science Publishers. 2015;8:169-94.

GONZALES, NICOLE

Meschia JF, Hopkins LN, Altafullah I, Wechsler LR, Stotts G, Gonzales NR, Voeks JH, Howard G, Brott TG. Time from Symptoms to Carotid Endarterectomy or Stenting and Perioperative Risk. *Stroke*. 2015 Oct 22; [Epub ahead of print] PMID: 26493675.

Zhao XR, Gonzales N, Aronowski J. Pleiotropic role of PPAR in intracerebral hemorrhage: an intricate system involving Nrf2, RXR, and NF- κ B. *CNS Neuroscience & Therapeutics*. 2015;21(4):357-66.

Zhao X, Sun G, Zhang J, Ting SM, Gonzales N, et al. Dimethyl Fumarate Protects Brain From Damage Produced by Intracerebral Hemorrhage by Mechanism Involving Nrf2. *Stroke*. 2015;46(7):1923-8.

HERGENROEDER, GEORGENE

Jeter CB, Hylin MJ, Hergenroeder GW, Hill J, Johnson DR, Barrera JA, Shields TC, Redell JB, Zhao J, Moore AN, Dash PK. Biomarkers of Organ Injury. *Recent Patents on Biomarkers*. 2014;4(2):92-109.

HOPE, OMOTOLA

Begley C, Shegog R, Harding A, Goldsmith C, Hope O, Newmark M. Longitudinal feasibility of MINDSET: a clinic decision aid for epilepsy self-management. *Epilepsy and Behavior*. 2015 Mar;44:143-50. [Epub 2015 Feb 20]

KALAMANGALAM, GIRIDHAR

Kalamangalam GP, Slater JD. Periodic lateralized epileptiform discharges and afterdischarges: Common dynamic mechanisms. *Journal of Clinical Neurophysiology* 2015. 32(4):331-40.

KIM, DANIEL H.

Park SH, Esquenazi Y, Kline DG, Kim DH. Surgical outcomes of 156 spinal accessory nerve injuries caused by lymph node biopsy. *Journal of Neurosurgery: Spine*. 2015 Oct;23(4):518-25.

LIU, YING

Li S, Xue H, Long B, Sun L, Truong T, Liu Y. Efficient generation of hiPSC neural lineage specific knockin reporters using the CRISPR/Cas9 and Cas9 double nickase system. *Journal of Visualized Experiments*. 2015;e52539, doi:10.3791/52539.

Li S, Xue H, Wu JB, Rao MS, Kim DH, Deng W, Liu Y. Human iPSC NEUROG2 dual knockin reporter lines generated by the CRISPR/Cas9 system. *Stem*

Cells and Development. 2015 Sept; [Epub ahead of print] doi:10.1089/scd.2015.0131.

Liu, Y. Treating spinal cord injury using human iPSC derived neural progenitor populations. NRC Newsletter, Volume 20, Number 2, Spring 2015.

Liu Y, Deng W. Reverse Engineering Human Neurodegenerative Disease Using Pluripotent Stem Cell Technology. Brain Research. 2015 Sept; [Epub ahead of print] doi: 10.1016/j.brainres.2015.09.023.

MEHANNA, RAJA

Matias CM, Mehanna R, Cooper SE, Amit A, Lempka SF, Silva D, Carlotti CG Jr, Butler RS, Machado AG. Correlation Among Anatomic Landmarks, Location of Subthalamic Deep Brain Stimulation Electrodes, Stimulation Parameters, and Side Effects During Programming Monopolar Review. Neurosurgery. 2015 Mar;Suppl 2:99-108.

Mehanna R. Deep Brain Stimulation. Nova Science Publishers, 2015.

Mehanna R. Deep Brain Stimulation in Parkinson's Disease. In: Deep Brain Stimulation. Nova Science Publishers, 2015:107-146.

Mehanna R. Deep brain stimulation: a historical review. In: Deep Brain Stimulation. Nova Science Publishers, 2015:1-18.

NELSON, FLAVIA

Banwell B, Ben-Zachariah A, Bowen J, Cohen B, Cree B, Dhib-Jalbut S, Kantor D, Nelson F, Sicotte N. The Use of Disease Modifying Therapies in MS: Principles and Current Evidence: A Consensus Paper by the Multiple Sclerosis Coalition. Expert review updated in March 2015.

Hasan KM, Lincoln JA, Nelson F, Wolinsky JS, Narayana PA. Lateral ventricular cerebrospinal fluid diffusivity as a potential neuroimaging marker of brain temperature in multiple sclerosis: A hypothesis and implications. Magnetic Resonance Imaging. 2015 Apr;33:262-69.

Nelson F, Poonawalla AH, Datta S, Banuelos RC, Rahbar MH, Perez F, Wolinsky JS, Narayana PA. Association of multiple sclerosis related cognitive impairment with an MRI-derived composite score. Journal of Multiple Sclerosis. 2014;1:124.

SANDBERG, DAVID

Arrey EN, Kerr ML, Fletcher S, Cox CS, Sandberg DI. Linear Non-Displaced Skull Fractures in Children: Who should be observed or admitted? Journal of Neurosurgery: Pediatrics. 2015;4:1-6.

Cykowski MD, Hicks J, Sandberg DI, Olar A, Bridge JA, Greipp PT, Navarro





P, Kolodziej S, Bhattacharjee MB. Brain Metastasis of Crystal-Deficient, CD68-Positive Alveolar Soft Part Sarcoma: Ultrastructural Features and Differential Diagnosis. *Ultrastructural Pathology*. 2015;3(1):69-7.

Luna B, Bhatia S, Yoo C, Fely Q, Sandberg DI, Duchowny M, Khatib Z, Miller I, Ragheb J, Prassana J, Roy D. Proteomic and Mitochondrial Genomic Analyses of Pediatric Brain Tumors. *Molecular Neurobiology*. 2015;52(3):1341-6.

Sandberg DI, Rytting M, Zaky W, Kerr M, Ketonen L, Kundu U, Moore BD, Yang G, Hou P, Sitton C, Cooper LJ, Gopalakrishnan V, Lee DA, Thall PF, Khatua S. Methotrexate Administration Directly into the

Fourth Ventricle in Children with Malignant Fourth Ventricle Brain Tumors: A Pilot Clinical Trial. *Journal of Neuro-Oncology*. 2015;125(1):133-41.

SCHIESS, MYA C.

Ellmore T, Murphy S, Cruz K, Castriotta R, Schiess MC. Averaging of Diffusion Tensor Imaging Direction-Encoded Color Maps for Localizing Substantia Nigra. *Computers in Biology and Medicine*. 2014 Aug;51C:104-10.

Furr-Stimming E, Boyle A, Schiess MC. Spasticity Management and Intrathecal Baclofen. In *Seminars in Neurology: Neurorehabilitation*, Eds. Gary Abrams and Karunesh Ganguly, Thieme Publishers. 2014;34:591-96.

Gayed I, Joseph U, Fanous M, Wan D, Schiess M, Ondo W, Won K-S. The Impact of DaTscan in the Diagnosis of Parkinson Disease. *Journal of Nuclear Medicine*. 2015;40(5):390-93.

Moro E, Schupbach M, Wachter T, Allert N, Eleopra R, Honey C, Rueda M, Schiess M, Shimo Y, Valkovic P, Whone A, Stoevelaar H. Referring Parkinson's disease patients for deep brain stimulation: A RAND/UCLA appropriateness study. *Journal of Neurology*. 2015 Nov 3; [Epub ahead of print] doi 10.1007/s00415-015-7942-x.

Riecke J, Johns K, Cai C, Vahidy F, Parsha K, Furr-Stimming, Schiess M, Savitz Sean. A Meta-Analysis of Mesenchymal Stem Cells in Animal Models of Parkinson's Disease. *Stem*

Cells and Development. 2015 Sept 15;24(18):2082-90.

Schiess M, Suescun J. Clinical Determinants of Progression in Parkinson Disease: Predicting Prognosis by Subtype. *JAMA Neurology*. 2015 Aug;72(8):859-60.

SCHULZ, PAUL

Arora G, Schulz PE. Neuropsychiatry. *Neurology Secrets*. In press 7/1/15.

Chitnis A, Schulz PE, Kunik ME, Aparasu RR, Chen H, Johnson ML. Use of statins and risk of dementia in heart failure: a retrospective cohort study. *Drugs & Aging*. 2015 Sep;32(9):743-54.

Chitnis A, Schulz PE, Kunik ME, Aparasu RR, Chen H, Johnson ML. Use of angiotensin-converting enzyme inhibitors, angiotensin receptor blockers and risk of dementia in heart failure. *American Journal of Alzheimer's Disease & Other Dementias*. In press, 09/07/15.

Cykowski MD, Takei H, Schulz PE, Appel SH, Powell S. TDP-43 pathology in the basal forebrain and hypothalamus of patients with amyotrophic lateral sclerosis. *Acta Neuropathological Communications*. 2014 Dec 24;2:171.

Galvez JF, Keser Z, Mwangi B, Ghouse AA, Fenoy AJ, Schulz PE, Sanches M, Quevedo J, Selvaraj S, Gajwani P,

Zunta-Soares G, Hasan KM, Soares JC. The Medial Forebrain Bundle as a Deep Brain Stimulation Target for Treatment Resistant Depression: A Review of Published Data. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*. 2015; Apr 3;58:59-70.

Jawaid A, Paganoni S, Hauser C, Schulz PE. Trials of Antidiabetic Drugs in Amyotrophic Lateral Sclerosis: Proceed with Caution? A Review. *Neurodegenerative Disease*. 2014;13:205-8.

Jawaid A, Schulz PE. Diabetes Mellitus in ALS: Dr. Jekyll or Mr. Hyde? *European Journal of Neurology*. Invited Editorial. 2015 Jan 18. doi: 10.1111/ene.12660.

Schulz PE, Arora G. Depression. *Continuum: Behavioral Neurology and Neuropsychiatry*. 2015 Jun;21(3):756-71.

SHIN, DONGSUK

Ishijima A, Schwarz RA, Shin D, Mondrik S, Vigneswaran N, Gillenwater AM, Anandasabapathy S, Richards-Kortum R. Automated frame selection process for high resolution microendoscopy. *Journal of Biomedical Optics*. 2015;20(4):046014.

Protano M-A, Xu H, Wang G, Polydorides AD, Dawsey SM, Cui J, Xue L, Zhang F, Quang T, Pierce

MC, Shin D, Schwartz RA, Bhutani MS, Lee M, Parikh N, Hur C, Wang X, Moshier E, Godbold J, Mitcham J, Thomas C, Richards-Kortum RR, Anandasabapathy S. Low-Cost High-Resolution Microendoscopy for the Early Detection of Esophageal Squamous Cell Neoplasia: An International Trial. *Gastroenterology*. 2015 Aug;149(2):321-29.

Shin D, Protano M-A, Polydorides AD, Dawsey SM, Pierce MC, Kim MK, Schwarz RA, Quang T, Parikh, N, Bhutani MS, Zhang F, Wang G, Xue L, Wang X, Xu H, Anandasabapathy S, Richards-Kortum RR. Automated image analysis of in vivo microendoscopic images for quantitative diagnosis of esophageal squamous cell carcinoma. *Clinical Gastroenterology and Hepatology*. 2015;13(2):272-9.e1.

Suzuki R, Bhutani MS, Shin D, Irisawa A, Fleming JB, Ohira H, Richards-Kortum R. Endoscopic ultrasound-assisted direct peritoneal visualization with a small-caliber scope - a proof of concept study in a swine model. *Endoscopic Ultrasound*. 2014;3(4):226-31.

SLATER, JEREMY

Kalamangalam GP, Slater JD. Periodic Lateralized Epileptiform Discharges and Afterdischarges: Common Dynamic Mechanisms. *Journal of Clinical Neurophysiology*. 2015 Aug;32(4):331-40.

SOTO, CLAUDIO

Mukherjee A, Syeb K, Concannon J, Callegari K, Soto C, Glicksman MA. Development of a high throughput assay to screen novel Calcineurin inhibitors. *PLOS ONE*. 2015 Jul 15;10.1371/journal.pone.0131297.

Pritzkow S, Morales R, Moda F, Telling GC, Hoover E, Soto C. Prion contaminated plants transmit prion disease. *Cell Reports*. 2015;11:1168-75.

Mukherjee A, Morales-Scheihing D, Butler PC, Soto C. Type 2 Diabetes as a Protein Misfolding Disease. *Trends in Molecular Medicine*. 2015;21:439-49.

Morales R, Bravo-Alegria J, Duran-Aniotz C, Soto C. Titration of biologically active amyloid- β seeds in a transgenic mouse model of Alzheimer's disease. *Scientific Reports*. 2015;5:9349.

Maheshwari A, Fischer M, Gambetti P, Parker A, Ram A, Soto C, Concha-Marambio L, Cohen Y, Belay ED, Maddox RA, Mead S, Goodman C, Kass JS, Schonberger LB, Hussein H. The Fourth Case of Variant Creutzfeldt-Jakob Disease in the United States: Global Implications. *Emerging Infectious Diseases*. 2015;21:750-59.

Morales R, Callegari K, Soto C. Prion-like features of misfolded A and tau aggregates. *Virus Research*. 2015; S0168-1702.

SMITH CALLAHAN, LAURA

Policastro GM, Lin F, Smith Callahan LA, Esterle A, Graham M, Sloan Stakleff K, Becker ML. OGP Functionalized Phenylalanine-Based Poly(ester urea) for Enhancing Osteoinductive Potential of Human Mesenchymal Stem Cells. *Biomacromolecules*. 2015 Apr 13;16(4):1358-71.

Yang YH, Khan Z, Ma C, Lim HJ, Smith Callahan LA. Optimization of adhesive conditions for neural differentiation of murine embryonic stem cells using hydrogels functionalized with continuous Ile-Lys-Val-Ala-Val concentration gradients. *Acta Biomaterialia*. 2015 Jul 15;21:55-62.

TANDON, NITIN

Cole AJ, So NK, Tandon N, Slater JD, Smith MC. Judgment is not ignorance. *Neurology*. 2014 Aug 26;83(9):847.

Conner CR, Shouval HZ, Hickok G, Tandon N. Robust Transient Dynamics Underpin Lexical Selection in Broca's Area. In re-review at PNAS.

Esquenazi Y, Savitz SI, Khoury RE, McIntosh MA, Grotta JC, Tandon N. Decompressive hemicraniectomy with or without clot evacuation for large spontaneous supratentorial intra-cerebral hemorrhages. *Clinical Neurology and Neurosurgery*. 2015;128:117-22.

Kadipasaoglu CM, Forseth K, Whaley M, Conner CR, Rollo MJ, Baboyan VG, Tandon N. Development of grouped icEEG for the study of cognitive processing. *Frontiers in Psychology*. 2015;6:1008.

Kalamangalam GP, Cara L, Tandon N, Slater JD. An interictal EEG spectral metric for temporal lobe epilepsy lateralization. *Epilepsy Research*. 2014 Dec;108(10):1748-57.

So NK, Cole AJ, Tandon N, Slater JD, Smith MC. Neurostimulation for the treatment of epilepsy: the skeptical view. *Neurology*. 2014 Aug 26;83(9):847-9.

WOLINSKY, JERRY

Arvin A, Wolinsky JS, Kappos L, Morris MI, Reder AT, Tornatore C, Gershon A, Gershon M, Levin MJ, Bezuidenhout M, Putzki N. Varicella-zoster virus infections in patients treated with fingolimod: Risk assessment and consensus recommendations for management. *JAMA Neurology*. 2015;72:31-9.

Datta S, Staewen TD, Cofield SS, Cutter GR, Lublin FD, Wolinsky JS, Narayana PA. Regional gray matter atrophy in relapsing remitting multiple sclerosis: Baseline analysis of multi-center data. *Multiple Sclerosis and Related Disorders*. 2015;4:124-36.



Govindarajan KA, Datta S, Hasan KM, Choi S, Rahbar MH, Cofield SS, Cutter GR, Lublin FD, Wolinsky JS, Narayana PA, MRI Analysis Center at Houston TCIG. Effect of in-painting on cortical thickness measurements in multiple sclerosis: A large cohort study. *Human Brain Mapping*. 2015 Oct;36(10):3749-60.

Hasan KM, Lincoln JA, Nelson F, Wolinsky JS, Narayana PA (2015) Lateral ventricular cerebrospinal fluid diffusivity as a potential neuroimaging marker of brain temperature in multiple sclerosis: A hypothesis and implications. *Magnetic Resonance Imaging*. 2015;33:262-69.

Kramer LA, Hasan KM, Sargsyan AE, Wolinsky JS, Hamilton DR, Riascos RF, Carson WK, Heimbigner J, Patel VS, Romo S, Otto C. Mr-derived cerebral spinal fluid hydrodynamics as a marker and a risk factor for intracranial hypertension in astronauts exposed to microgravity. *Journal of Magnetic Resonance Imaging*. 2015 Apr 27; [Epub ahead of print] doi: 10.1002/jmri.24923.

Miller A, Macdonell R, Comi G, Freedman M, Kappos L, Mäurer M, Olsson T, Wolinsky J, Bozzi S, Dive-Pouletty C, O'Connor P. Teriflunomide reduces relapses with sequelae and relapses leading to hospitalizations: results from the TOWER study. *Journal of Neurology*. 2014;261:17811-8.

Miller AE, Wolinsky JS, Kappos L, Comi G, Freedman MS, Olsson TP, Bauer D, Benamor M, Truffinet P, O'Connor PW, for the TOPIC Study Group. Oral teriflunomide for patients with a first clinical episode suggestive of multiple sclerosis (TOPIC): a randomised, double-blind, placebo-controlled, phase 3 trial. *The Lancet Neurology*. 2014;13:977-86.

Wolinsky JS, Borresen TE, Dietrich DW, Wynn D, Sidi Y, Steinerman JR, Knappertz V, Kolodny S. GLACIER: An open-label, randomized, multicenter study to assess the safety and tolerability of glatiramer acetate 40mg three-times weekly versus 20mg daily in patients with relapsing-remitting multiple sclerosis. *Multiple Sclerosis and Related Disorders*. 2015;4(4):370-6.

WU, JIAQIAN

Chen K, Dai X, Wu JQ. Alternative splicing: An important mechanism in stem cell biology. *World Journal of Stem Cells*. 2015;7(1):1-10.

Chen K, Dong X, Wu JQ. The Application of single-cell sequencing in dynamic transcriptomes. *Single Cell Sequencing*. X. Wang (ed.), *Single Cell Sequencing and Systems Immunology, Translational Bioinformatics 5*. Springer Publisher Dordrecht 2015. 41-63.

Dong X, You Y, Wu JQ. Building an RNA-sequencing transcriptome of the nervous system. *The Neuroscientist*. 2015 Oct 13. [Epub ahead of print] doi: 10.1177/1073858415610541.

Dong X, Muppani NR, Wu JQ. Long Non-coding RNAs: Critical Regulators for Cell Lineage Commitment in the Central Nervous System. Wu, J. Q. (ed.), *Bioinformatics in Transcriptomics and Gene Regulation*. Springer Publisher Dordrecht 2015.

Duran R, Menon S, Wu JQ. The Analyses of Global Gene Expression and Transcription Factor Regulation. Wu, J. Q. (ed.), *Bioinformatics in Transcriptomics and Gene Regulation*. Springer Publisher Dordrecht 2015.

Yan Q, Weyn-Vanhentenryck SM, Wu J, Sloan S, Zhang Y, Chen K, Wu JQ, Barres B, Zhang C. Systematic discovery of regulated and conserved alternative exons in the mammalian brain reveals NMD modulating chromatin regulators. *PNAS*. 2015 Mar 17;112(11):3445-50.

XIA, YING

Cao S, Chao DM, Zhou HH, Balboni G, Xia Y. A novel mechanism for cytoprotection against hypoxic injury: DOR-mediated increase in Nrf2 translocation. *British Journal of Pharmacology*. 2015;172:1869-81.

Chen F, Qi ZF, Luo YM, Hinchliffe T, Ding GH, Xia Y, Ji XM. Non-pharmaceutical therapies for stroke: Mechanisms and clinical implications. *Progress in Neurobiology*. 2014;20:191-201.

Chen T, Li J, Chao DM, Sandhu HK, Liao XP, Zhao JL, Wen GQ, Xia Y. δ -Opioid receptor activation reduces α -synuclein overexpression and oligomer formation induced by MPP+ and/or hypoxia. *Experimental Neurology*. 2014;255:127-36.

Fenoy AJ, Goetz L, Chabardès S, Xia Y. Deep Brain Stimulation: Are Astrocytes a Key Driver Behind the Scene? *CNS Neuroscience and Therapeutics*. 2014;20:191-201.

Jiang B, Shen RF, Bi J, Tian XS, Hinchliffe T, Xia Y. Catalpol: A Potential Therapeutic for Neurodegenerative Diseases. *Current Medicinal Chemistry*. 2015;22:1278-91.

Liang J, Tong P, Zhao W, Li Y, Zhang L, Xia Y, Yu Y. The REST Gene Signature Predicts Drug Sensitivity in Neuroblastoma Cell Lines and Is Significantly Associated with Neuroblastoma Tumor Stage. *International Journal of Molecular Sciences*. 2014;15:11220-33.



Liang JF, Chao DM, Sandhu HK, Balboni G, Kim DK, Xia Y. δ -Opioid receptors up-regulate excitatory amino acid transporters of astrocytes in the mouse brain. *British Journal of Pharmacology*. 2014;171:5417-30.

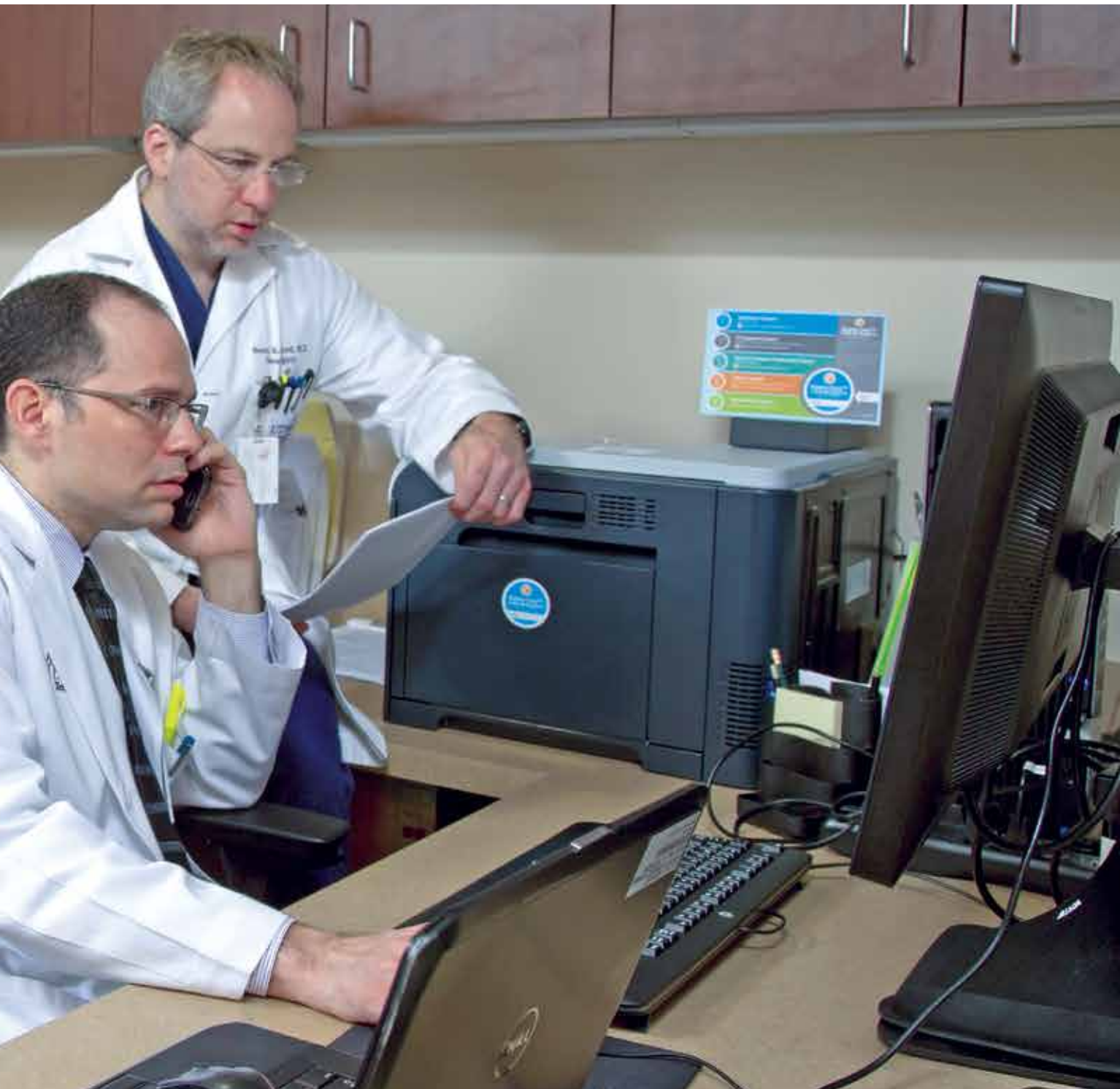
Wang QY, Chao DM, Xia Y. δ -opioid receptors and inflammatory cytokines in hypoxia: Differential regulation between neuron-like and glial cells. *Translational Stroke Research*. 2014;5:476-83.

Xu Y, Wei X, Liu X, Liao J, Lin J, Zhou P, Zhu C, Meng X, Xie D, Chao DM, Fenoy AJ, Cheng M, Tang B, Xia Y, Wang Q. Low Cerebral Glucose Metabolism: A Potential Predictor for the Severity of Vascular Parkinsonism and Parkinson's disease. *Aging and Disease*. 2014. Abstract available online at aginganddisease.org.

Yang YL, Sandhu HK, Zhi F, Hua F, Wu M, Xia Y. Effects of hypoxia/ischemia on brain microRNAs. *Current Medicinal Chemistry*. 2015;22:1292-1301.

Patient Stories





Miles McDonough: Unstoppable

In September 2011, alpine enthusiast and search-and-rescue team member Miles McDonough fell 65 feet while scaling Mount Stuart in the North Cascade Mountains of Washington state. In the accident, he fractured his right humeral head and scapula, an injury that damaged the brachial plexus nerves controlling movement of the shoulder and biceps muscles. Twenty hours passed before he was rescued and transported to emergency care.

McDonough spent the first eight weeks of his recovery with his right arm immobilized in a sling, and when the sling came off, he was unable to move his upper arm and shoulder. After three months of physical therapy with no significant improvement, the nerve injury became apparent. He and his family began their search for an expert in peripheral nerve surgery.

“My family and I found experienced neurosurgeons at the Mayo Clinic and at Washington University in St. Louis, but ultimately we decided to see Dr. Daniel Kim because of his exceptional training, experience and reputation,” he says.

Internationally renowned neurosurgeon Daniel H. Kim, M.D., FACS, FAANS, is known for his expertise in reconstructive peripheral nerve surgery, complex spinal reconstruction and minimally invasive spinal surgery, both endoscopic and robotic. A clinical and educational leader in his field, Dr. Kim has authored hundreds of papers and published 20 surgical textbooks, many of which are used at leading medical schools to teach standard-of-care techniques for neurosurgery.

He is a pre-eminent researcher in peripheral nerve repair through nerve transfer and nerve graft, and is also recognized for his work in neurorehabilitation through robotics and cortical stimulation, spinal biomechanics and innovative neuromodulation treatments for chronic pain.

By the time McDonough found Dr. Kim, the six-month window for successful reconstructive peripheral nerve surgery had almost passed. Dr. Kim rearranged his schedule to accommodate McDonough, who flew to Houston accompanied by his father, a urologist, and his mother, a registered nurse. A week later, on March 14, 2012, Dr. Kim took his patient to the OR.

“Dr. Kim took great care to explain the surgical procedure and also provided objective data on previous surgeries he’d performed so that I knew the risks and benefits of the surgery I was electing to undergo,” McDonough says. “Based on the empirical data and Dr. Kim’s experience, I knew I had a 75 percent chance of improvement.”

Dr. Kim has published more than 150 articles on reconstructive peripheral nerve repair in peer-reviewed journals and is the author of three textbooks on the subject. “We harvested the sural donor nerve from his right leg and used it as a graft to repair several branches of his supra scapular nerve,” he says. “We also performed a nerve transfer procedure to the nerve innervating the deltoid muscle in the same arm. Once the connection was reestablished, we waited for the nerve to regenerate.”



“I’ve been able to participate in more than 25 missions since regaining function of my arm. Your great work on my shoulder has indirectly had a positive effect on the lives of many other people.”

After a year of physical therapy, McDonough recovered nearly 100 percent of the function he’d lost in his right arm and shoulder. By April 2013, he had returned to work as an emergency medical technician with the Snohomish County Helicopter Helicopter Rescue Team.

In an email to Dr. Kim dated May 2015, McDonough wrote, “Thanks to my successful recovery I was able to return to alpine climbing and ski mountaineering, two of the most significant passions in my life. Even more importantly I was able to continue my work with the rescue team. I’ve been able to participate in more than 25 missions since regaining function of my arm, and in March 2015 our team was recognized with the Airbus Helicopters Golden Hour Award for the Helicopter

Association International for our rescue work. Your great work on my shoulder has indirectly had a positive effect on the lives of many other people.”

After completing two years of prerequisite coursework, McDonough began work on his medical degree at the University of Washington School of Medicine in the fall of 2015. “The care I received from Dr. Kim inspired me to strive for excellence in my new career so that someday I will be able to provide a similar level of care to others in dire straits,” he says. “As I gradually take on the role and responsibilities of a physician and begin providing care to my own patients, I’ll always be grateful for the care Dr. Kim provided me.”

Carlos Velázquez: Cancer Is Just a Word

Every other month, Carlos Velázquez and his wife, Mónica Costa, make the 12,500-mile round trip between their home in Asunción, Paraguay, and Houston, Texas, where Velázquez is undergoing an innovative treatment for glioblastoma multiforme (GBM). The Paraguayan couple and their Texas Medical Center neuro-oncology team have broken the barriers of distance and communication, allowing Velázquez to benefit from advanced treatments available at the Memorial Hermann Mischer Neuroscience Institute.

The couple's journey began on Jan. 21, 2014. During his daily seven-kilometer run through a park near his home, Velázquez, a healthy 55-year-old, became dizzy and developed uncontrollable shaking in his left leg. The episode was brief, but he lost consciousness and was taken to the emergency room of a nearby hospital, where an MRI of the brain revealed a right parasagittal tumor located on the motor strip, the part of the right frontal lobe that controls left leg movement. Velázquez underwent a craniotomy and biopsy on Jan. 25; two days later, he and his wife heard the diagnosis: WHO grade 4 GBM.

"We knew GBM was not a good diagnosis, so we started asking friends about hospitals where we could have treatment," Costa says. "A close friend, whose cousin was treated for GBM by Dr. Jay Zhu in Houston, advised us to talk with Dr. Gustavo Ayala, a pathologist from Paraguay who is a professor at UTHealth Medical School.





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“We weren’t familiar with the Gamma Knife procedure, but we had complete trust in Dr. Zhu and his team. The procedure was painless, and the result was spectacular. To our surprise, the tumor shrank.”

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PATIENT STORIES

We did, and Dr. Ayala told us yes, you must see Dr. Zhu. So when we came to Houston, we knew only of Dr. Zhu.”

A fellowship-trained neuro-oncologist at the Mischer Neuroscience Institute and an associate professor at UTHealth Medical School, Jay-Jiguang Zhu, M.D., Ph.D., focuses his practice on primary brain tumors and primary CNS lymphomas, as well as brain metastases and leptomeningeal spread of systemic malignancies. Just three weeks after Velázquez and Costa heard the diagnosis, they met with Dr. Zhu and radiation oncologist Angel Blanco, M.D., at the Mischer Neuroscience Institute.

“When people in Paraguay, more than 6,000 miles away from Houston, say you will go to the Texas Medical Center, which is well known worldwide, and you will be seen by a person who is renowned, you wonder what kind of people you’ll meet,” Costa says. “We didn’t believe we could get an appointment with such a person as Dr. Zhu in 10 days, but we did. That first sign of hospitality gave us an idea of what we could expect in the future.”

Later the same day, the Mischer Neuroscience Institute Tumor Board discussed Velázquez’s case and came to a consensus to start standard-of-care treatment – six weeks of conformal irradiation with concurrent temozolomide – as soon as possible. He began treatment the following day.

In May, four weeks after Velázquez completed radiation therapy and the initial course of temozolomide, Dr. Zhu’s team offered him the opportunity to enroll in the NovoCure clinical trial investigating the safety and effectiveness of the NovoTTF-100A, together with temozolomide, in patients with newly diagnosed glioblastoma multiforme. The medical device was FDA approved for treatment of recurrent GBM in April 2014.

A locally delivered treatment, the NovoTTF-100A uses electric fields within the human body to disrupt the rapid division and spread of cancer cells. Developed to provide physicians and patients with a fourth treatment option for GBM in addition to surgery, radiation therapy and chemotherapy, TTF therapy is designed for continuous use during the day and night by patients, with portable battery packs that allow them to maintain their normal daily routine while undergoing treatment. Velázquez will wear the NovoTTF-100A for two years.

“Studies have shown that low-intensity, intermediate-frequency electric fields stunt the growth of tumor cells,” Dr. Zhu says. “The device administers alternating electric fields to the region of the malignant tumor by means of surface electrode arrays. Our entire neuro-oncology team was happy when Carlos was randomized to the treatment arm of the clinical trial.”

In May 2015, when the tumor showed progression, Velázquez underwent Gamma Knife® radiosurgery by Dong Kim, M.D., director of the Mischer Neuroscience Institute and professor and chair of the Vivian L. Smith Department of Neurosurgery, and Dr. Blanco, who is a clinical assistant professor in the division of Oncology at UTHealth Medical School.

“We weren’t familiar with the Gamma Knife procedure, but we had complete trust in Dr. Zhu and his team,” Costa says. “The procedure was painless, and the result was spectacular. To our surprise, the tumor shrank.”

Following radiosurgery, Dr. Zhu added two additional FDA-approved therapeutic modalities to the NovoCure/temozolomide treatment regimen – Avastin® and irinotecan. “The combination of these four therapies is one of many things unique about Carlos’ case,” he says.

“This is a very aggressive treatment that I prescribe for younger, healthier patients. Because the combination may have side effects, we follow Carlos meticulously, working closely with his oncologist in Asunción.”

Today, the couple continues to make the trip – 20 hours each way. “It’s a long trip, especially considering that my husband is an oncology patient,” Costa says. “But when Dr. Zhu enters the room smiling, you say to yourself, ‘Well, this is good.’ We expected some kind of very serious and distant doctor. What we found was exactly the opposite. He is so warm and so clear about what we can expect. He finds ways to adjust to your budget or the resources we have in our country without compromising the treatment. So many people think they can’t afford the treatment or maybe they are afraid of the trip. I would like to encourage people not to be afraid of the travel and the language barrier. The hospitality has been wonderful.”

Dr. Zhu says that the couple’s attitude is the key to success, in addition to the therapies. “Carlos is exercising, and he’s very upbeat,” the neuro-oncologist says. “He puts his best efforts into whatever we recommend. His wife is a pillar, and his family provides excellent care and support. They have overcome the barrier of distance because they feel it’s worth the travel and expense to be treated at the Mischer Neuroscience Institute.”

For their part, Velázquez and Costa stay focused on their hopes and plans. “We are not only stable, but we are better,” Costa says. “My husband is a wonderful, relentless man. If Dr. Zhu suggests five abdominal exercises, he does 20. He really is a one-of-a-kind man. That, along with the team we have, helps make everything a joy.”

Velázquez remains positive. “I came here with cancer, and I was very anxious but with Dr. Zhu, I feel confident,” he said through an interpreter. “I used to travel a lot in my professional life, and now I travel to get the best treatment. It makes me really tired but we always make a stop in Miami to relax.”

“Cancer is just a disease of the body,” Costa adds. “We will not let the cancer take our spirit, our faith or our souls. So every time we come to Houston, we plan our stopover in Miami, where my sister-in-law lives. We plan where to dine and what to do, so we can have fun along the way. That makes us less anxious. We don’t need anxiety. We need to be sure and calm. As Christians, we don’t believe in coincidences, we believe in ‘God-incidences’ and God led us to Houston. We know the treatment is aggressive and difficult, but we trust Dr. Zhu’s team because we know we are here on earth in the best hands. We pray every day for all of them.”

Carlos Velázquez and Mónica Costa wish to thank all the healthcare professionals at the Mischer Neuroscience Institute – from physicians, nurses and technicians to staff in the Finance Department and International Services – who have helped them along the way. They are especially appreciative of the efforts of Dr. Zhu’s research team for the NovoCure trial, including clinical trial coordinators GuangRong (Greg) Lu and Mayank Rao, and also for the assistance of Amy Luton, technical service representative for NovoCure.



“Finally my husband said, ‘You shouldn’t have to live like this. There must be something that can be done.’ And there was. Now I can do things I haven’t been able to do for years.”

Susan Muñoz: **Out of the Shadow of Pain**

Bent over in her son's room, Susan Muñoz felt a pop in her back when she stood up. It was 2007, and she and her family had just moved into a new home.

"I was in terrible pain and was trying to paint the house and do all kinds of things I shouldn't have been doing," Mrs. Muñoz says. "I saw a pain management specialist, who tried a series of facet injections in my spine, but they provided no real relief. With the pain I was averaging three to four hours of sleep a night and couldn't focus on anything."

After learning she had desiccated and collapsing disks, Mrs. Muñoz underwent two spine fusions with implanted interbody cages for fixation, one in 2009 and the other in 2012. The pain improved but never went away. "We could never quite get a handle on the sciatica," she says. "Between 2009 and 2014, I was taking three heavy-duty pain medications. After the last surgery I saw a physical therapist who was very good, but my sciatica would flare up and I couldn't do the exercises he prescribed. I had pretty much given up when I found Dr. Dhanani. She gave me hope at a time when I really needed it."

Nadya Dhanani, M.D., is an interventional pain management specialist at Mischer Neuroscience Associates-Texas Medical Center and a clinical assistant professor in the Vivian L. Smith Department of Neurosurgery at UTHealth Medical School. After talking with Muñoz and evaluating her condition, Dr. Dhanani prescribed sacroiliac (SI) joint injections for SI joint dysfunction. Mrs. Muñoz received the injections over the course of a year; each injection provided relief for about three months.

In June 2015, after trying more conservative measures, Dr. Dhanani performed a radiofrequency ablation of the nerves supplying the sacroiliac joint. "Radiofrequency denervation procedures provide more prolonged pain relief compared to sacroiliac joint injections," Dr. Dhanani says. "This is not a procedure we perform frequently, but in certain patients like Susan, who get only transient relief from SI injections, it is appropriate. She responded very well."

The procedure will provide six to 12 months of pain relief before the nerve repairs itself. "Before Dr. Dhanani, we went on vacation to Hawaii, and I couldn't enjoy myself because of the pain," Mrs. Muñoz says. "Finally my husband said you shouldn't have to live like this. There must be something that can be done. And there was. Now I can do things I haven't been able to do for years. I still have pain, but it's minor versus major."

"Susan is one of my success stories. When I first met her, she was in an extraordinary amount of pain," Dr. Dhanani says. "She'd almost given up on having a normal life. Over the year that we've been working together, she has minimized her dependence on narcotic medication in addition to increasing her range of activities. Although she's not pain free, her quality of life has improved dramatically."

Mrs. Muñoz sees Dr. Dhanani every three months. "She treats me as if I'm her only patient, always taking time to listen," she says. "There's a feeling of family and friendship in her office. They're all very caring. I know when I go there, I'll get relief."

Darius Sonia: The Perfect Candidate

A caring and informed mother, a knowledgeable physical therapist, and an expert in the surgical management of spasticity have transformed the life of eight-year-old Darius Sonia.

Born seven weeks early, Darius suffered an intraventricular hemorrhage in the first few days of life – a common occurrence with premature birth. The hemorrhage left him with a single, significant deficit: spasticity in the lower limbs.

“Darius has been in therapy since he was three months old,” says his mother, Sarah Sonia, who moved to Houston from Shreveport, Louisiana, in 2008, about a year after her son’s birth. “In therapy he learned to stretch his muscles and improve his range of motion, but eventually the tightness would come back. When he was about five, I started considering a dorsal rhizotomy, which requires a year of intensive physical therapy following the surgery. But a presurgery evaluation showed he had ADHD. We didn’t think he could concentrate well enough to do three or four days a week of hour-long therapy sessions after the surgery.”

Selective dorsal rhizotomy (SDR) is a neurosurgical procedure that selectively destroys problematic nerve roots in the spinal cord and is most often done in children to relieve the symptoms of spastic diplegia or spastic hemiplegia. Performed correctly in the right surgical hands, the procedure provides an immediate, permanent reduction in spasticity and offers children who follow a program of intensive postoperative therapy the potential to walk independently within one to two years.

After the ADHD evaluation, Sonia had reservations about starting her son on medication. “I wasn’t sure about Ritalin but it turned out to be a good decision,” she says. “He took it for two years with good results. In the meantime, we changed therapists and I started reconsidering dorsal rhizotomy.”

The new therapist was Christine Hill, PT, of Therapy 2000, which provides in-home physical, occupational and speech therapy for pediatric patients. Hill thought Darius would do well with SDR and suggested they ask for a referral to Manish Shah, M.D., an assistant professor in the department of Pediatric Neurosurgery at UTHealth Medical School and the leading neurosurgeon in the area for selective dorsal rhizotomy. Dr. Shah is fellowship trained in pediatric neurosurgery with special expertise in the surgical management of spasticity and dystonia in children, and performs selective dorsal rhizotomies and baclofen pump placement, using advanced techniques. An expert in pediatric epilepsy, craniofacial surgery and craniocervical spine surgery, Dr. Shah was recruited from Washington University in St. Louis after completing his fellowship at St. Louis Children’s Hospital under world-renowned pediatric neurosurgeon Tae Sung Park, M.D.

“We do selective dorsal rhizotomy with a single incision at one to one-and-a-half levels of the spine and cut 75 to 80 percent of the nerve rootlets,” Dr. Shah says. “Most providers use longer incisions and cut only about 30 percent of the rootlets. Evidence shows that this approach often fails in the long term, with a return of the spasticity. We see many patients with failed rhizotomies and unfortunately, there’s nothing we can do for them.”



“

“He always wanted to participate in some kind of sport but because of his balance problems, I never thought he’d be able to. Now he’s taking karate, doing kicks and punches, and talking about how he wants to play football and be a quarterback.”

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PATIENT STORIES

It's a one-shot procedure. If parents are considering rhizotomy, we strongly encourage them to be evaluated at Children's Memorial Hermann Hospital in Houston." Darius was the perfect candidate for SDR, according to well-established criteria for success: the spasticity was limited to his legs, he had good trunk control and no previous orthopedic procedures, he could tolerate physical and occupational therapy and he had strong family support.

In June 2015, Dr. Shah took Darius to the OR where he performed a one-level laminectomy and unroofed the spinal canal in the mid-lower back. After exposing the dorsal sensory nerve roots, he divided them into rootlets and tested them one by one, cutting about 75 percent of the most spastic rootlets. The surgery took two-and-a-half hours.

Darius spent 48 hours on bedrest and was up and active immediately afterward. After a four-day stay at Children's Memorial Hermann Hospital, he was transferred to Shriners Hospital for Children in the Texas Medical Center for inpatient rehabilitation. Therapy began as soon as he was admitted.

"When I went to see Darius to remove the bandage a week and a half after surgery, he was already up roaming the hallway in a wheeled walker," Dr. Shah says. "What a sweet kid! He's enthusiastic and adorable and very motivated to walk. We all win the lottery in different ways. He was premature and had the intraventricular hemorrhage but his mom educated herself about his condition and found excellent therapists. In our experience young patients with a strong desire to succeed and good family support can achieve independent walking."

Darius was released from Shriners Hospital a week earlier than expected. "The surgery was a good decision for him," his mother says. "He always wanted to participate in some kind of sport but because of his balance problems, I never thought he'd be able to. Now he's taking karate, doing kicks and punches, and talking about how he wants to play football and be a quarterback. His muscles are getting stronger and he's doing things he couldn't do before the surgery." Darius turned eight in August 2015. He continues therapy three times a week, and Dr. Shah sees him every three months in follow-up, which will continue for at least another year.

"We like to follow patients over time as part of their care team so we can continue to help them improve their mobility," he says. "We're not the kind of practice that operates on kids and discharges them into the wild. We're very committed to the long-term welfare of our patients and their families."

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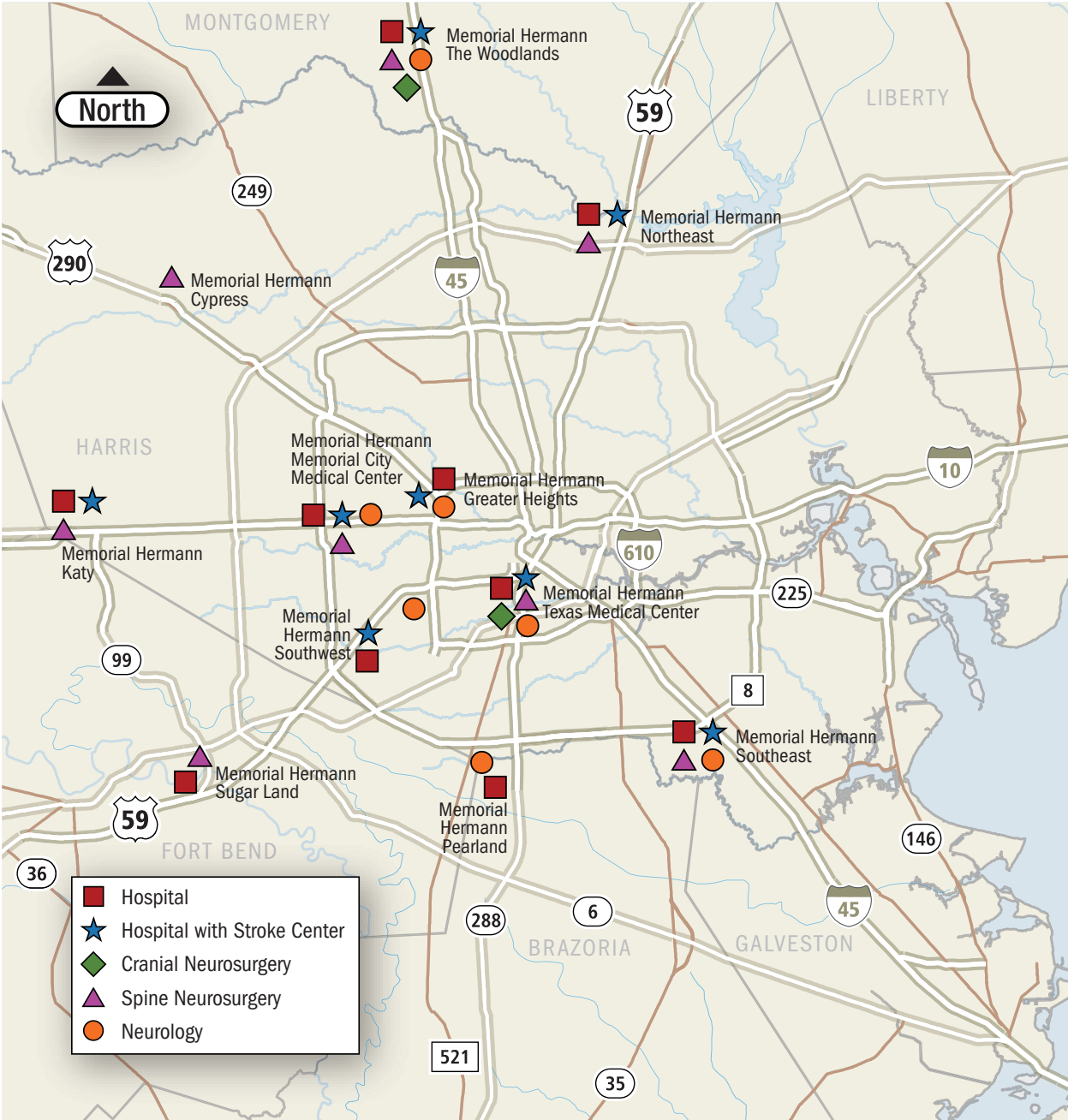
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MISCHER NEUROSCIENCES LOCATIONS



MNI's infrastructure expansion has allowed the Institute to extend its neuroscience expertise and capabilities outside the Texas Medical Center and into the community through the development of neuroscience centers at Memorial Hermann community hospitals and beyond. Together, the centers bring distinctive subspecialty services to the community, and when combined with the specialized skills of neurosurgeons and neurologists at MNI, they offer suburban patients comprehensive consultation, evaluation and treatment for a range of disorders.



The physicians and researchers at the Mischer Neuroscience Institute stand at the threshold of breakthrough discoveries that will transform how to treat and cure neurological diseases and disorders. In partnership with the philanthropic community, they have recruited exceptional clinicians and researchers and funded leading-edge technology and research. Yet, work remains to be done.

We need your help to touch more lives. **Please consider making a tax-deductible gift to the Memorial Hermann Foundation in support of the Mischer Neuroscience Institute.** Your gift will help MNI attain an unprecedented level of scientific discovery that will lead to transformative treatments for our patients.

For more information on funding needs at the Mischer Neuroscience Institute or to make a gift, visit memorialhermannfoundation.org or call 713.242.4400.



Mischer
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